SOCIABOTS: A Robotic Approach for Special Education Children to Improve their Social Skills

by

Nurul Husna binti Mukhtar
16260

A dissertation submitted in partial fulfillment of the requirement for the
Bachelor of Technology (Hons)
(Information and Communication Technology)

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CERTIFICATION OF ORIGINALITY

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Approved by,

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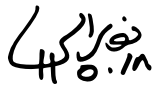
UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

MAY 2015

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.



Nurul Husna binti Mukhtar

ABSTRACT

Social behavior for special-needs children is crucial to ensure that the special-needs children know how to communicate and establish social relationship with others. Children with special-needs such as Autism Spectrum Disorder (ASD), Attention Deficit Hyperactive Disorder (ADHD), Down syndrome and Slow Learner usually have problems in socializing as they usually have empathy deficit. The current pedagogy used by teachers also are unattractive making them unable to attract the children's attention and making them unable to stimulate the children's kinetic senses and tactile senses thus affecting the learning rates of the special-needs children. Therefore, to address this issues, SOCIABOTS, a NAO robotic approach for the special education children to improve their social skills is developed as to aid teachers in their teaching process. This robotic application is able to play shapes game with the special-needs children and dance after they accomplish the task correctly. It is a perfect solution for both of the special-needs children and the special education teachers as it caters both needs. This robotic module focuses on making learning turn taking attractive to sustain the special-needs children' attention while stimulating their tactile and kinetic senses. The RAD methodology is used for development of this robotic module. Surveys, interviews and observations are the source of data to gather information and opinion for the development of SOCIABOTS. A shape recognition test is conducted to determine which background color works better in recognizing shapes. A field test at the Sekolah Kebangsaan Sultan Yussuf, Batu Gajah, Perak with 5 special education students was conducted to compare the effectiveness of SOCIABOTS against the current pedagogy used by teachers. The results show that SOCIABOTS helps in sustaining the special-needs children' attention and helps in assisting the teachers in teaching. It scores better compared to the current pedagogy that the teachers used in classes. This module is focusing on assisting teachers in their teaching process and helps special-needs children learning taking turns interactively thus improving their social skills.

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ABBREVIATIONS AND NOMECLATURES

DRAMA	Dynamical Recurrent Associative Memory Architecture
SDLC	System Development Life Cycle
RAD	Rapid Application Development
UTP	Universiti Teknologi PETRONAS

CHAPTER 1
INTRODUCTION

1.1 Background of Study

It is very important for children to learn to adhere to social rules, for example, taking turns and sharing items. Special-needs children have problems in adhering to social rules. These children cannot distinguish people's action and response due to their inflexibility in thinking. As a result, they are facing problems in socializing. They have false-belief task difficulties and do not establish social behavior. Teachers are having a hard time to train these children in adhering to social rules. With the rise of artificial intelligence and use of robots in special-needs children' therapy, improvement on the teachers' social behavior-teaching module can be applied to support their teaching method so that it is easier to teach the special-needs children to adhere to the social rules. It also helps these children to improve their social interaction so that one-day, they can communicate and socialize like other children. Despite their mental challenges, they surely need to learn to communicate like normal children to function in social situations.

1.2 Problem Statements

Adherence to social rules is important to ensure that these special-needs children know how to react to peoples' action so that they can communicate and socialize with others thus, improving their social life. Few problems have been identified with regards to this matter.

1.2.1 Social Behavior

Children with special needs usually have empathy deficiency. These children usually develop a little gratitude or no gratitude at all to other people's feelings or ideas. For them, their own feelings and ideas are the only feelings and ideas that exist in their life. They are not sensitive to people's action and words. As they have an empathy deficiency, they feel that they cannot predict social communications and become frightened of it. They usually take refuge and comfort in their own isolated worlds and tend to avoid social relationships. In addition, these children might have a different emotional behavior that others do not understand. Their social fears can show aggression or compulsive behaviors that may result in tantrums and self-injurious behaviors (Reynolds, n.d.).

1.2.2 Unattractive Teaching Aids

Currently, most of the teaching techniques uses are either by using visual or auditory teaching method. Teachers are currently teaching the children by stimulating their sight senses in looking at pictures from the board, flash cards or screens. Their auditory sense or hearing sense is used to listen to the teacher says or to listen to the animation sounds. These children may have difficulties in tracking and visual processing or they may have weak auditory processing due to unattractive teaching aids those teachers has used. In order to solve these difficulties, the teachers should involve more of the children's senses especially tactile (touch) senses and kinetic (movement) senses, thus, helping the brain to memorize easier from the tactile memories, kinetic memories, including auditory memories and visual memories (Praveen, n.d.).

1.2.3 Slow Improvement

The learning rate of the special-needs children in gathering new knowledge and skill is below the learning rate of normal children. The number of correct response from a student without assistance from others measures the learning rate. They also usually

have problems in focusing to the learning task and focuses on the distracting stimuli instead. As they have problem in sustaining attention in learning tasks, it contributes to the special-needs children' abilities in gathering, memorizing and generalizing new skills and information (Zeaman & House, 1979). Some special-needs children have lack of learning and problem solving tasks as they try to minimize failures after going through a set of failures by setting a low expectation to himself and do not try very hard to solve the tasks. They tend to depend on others as they do not trust their own solution and rely on others for assistance (Switzky, 1997).

1.3 Objectives

There are 4 main objectives that have been identified for this project:

1. To study the awareness of the public on the teaching and learning methods for special education.
2. To investigate the problem of special-needs children in adhering turn-taking and sharing items.
3. To develop a robotic application that can help special-needs children to improve their turn-taking activities through games.
4. To test the developed prototype on real individuals diagnosed with special-needs against the current teaching and learning method for developing social behavior.

1.4 Scope of Study

1.4.1 Characteristic of special children

The best method to teach the special-needs children is always by using human intervention. The focus of this project is to assist teachers in their teaching process without substituting the teachers as the main teacher. Since robots are emotionless, it is a disadvantage because they cannot teach the special-needs children with care and the robot does not deal with the special-needs children with patience. The robot body needs

to be handled carefully and it is better if the teacher handle it instead of the children, as the behavior of the special-needs children is difficult to predict. Therefore, the project is concentrating on aiding the communicational deficiency so that they can grab the lesson taught by the teachers. The special-needs children to be tested are the children with Autism Spectrum Disorder (ASD), Attention Deficit Hyperactivity (ADHD), slow-learner and down syndrome which have normal eye movement, no hearing and visual deficiency. They should have a non-aggressive behavior and are able to follow simple commands.

1.4.2 Robot requirements

Based on a study done by Gullian N., there are few requirements needed for developing a robot for special-needs children. First, the robot must be attractive yet has a careful balance in order to avoid the children to over-stimulate as the special-needs children doesn't like different face expressions. The face should have a simple format that helps to prevent overstimulation. The appearance of the robot should not be too realistic as it may reduce the child's interest but it must also not too mechanical to avoid the children to be more interested in examining the components rather than communicating. The robot should be perceived as a human but is recognized as a robot via its mechanical properties. The robot should also have a size of a human toddler. The resemblance of size will make the robot more interesting and allow the children to be at the robot's eye-level. In order to enhance the feeling of the toddler-size robots, the robot should also have degrees of motion that is similar to a human toddler. The robots should also be able to move small objects. This project proposes the use of NAO humanoid robot as shown in Figure 1.1.

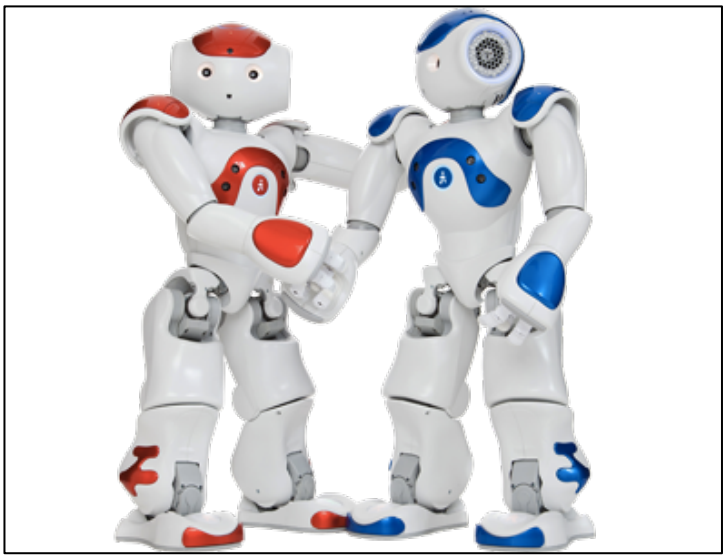

FIGURE 1.1 NAO Humanoid Robot

1.4.3 The design on the module

The robotic module will based on playing games while interacting with the robot in order to create opportunities for tactile experiences. After they succeed the task given by the robot, the children will be given something as a reward. Since, these children are slower than normal children, a module that use usable language will be designed in order to make sure the children understand and can follow the instruction given by the robot. So, the focus here is to develop a NAO teaching module that emphasizes game-based activities, giving out rewards and use usable languages in order to attain the special-needs children's focus.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

This chapter discusses the nature of special-needs children, followed by the current pedagogy used in teaching social behavior and how technology helps to improve the social behavior through technology applications.

2.2 Special-needs

According to Oxford Dictionary, special-needs in the context of children at school refer to the students with learning difficulties, emotional and behavioral difficulties or physical abilities in particular to their educational requirements. According to Mauro, (n.d) special-needs are usually defined by what a child cannot do such as unmet milestones, experiences denied, foods banned and activities avoided. They may have mild learning problems or acute cognitive impairments.

According to National Center for Parent Information and Resources (NCPIR), there are few types of special-needs for example, Attention Deficit or Hyperactivity Disorder, Autism or Pervasive Development Disorder, Visual Impairment, Cerebral Palsy, Developmental Delay, Down syndrome, Emotional Disturbance, Intellectual Disability, Learning Disabilities and Speech and Language Impairments.

There are few characteristic that these disabilities shares in common such as hard to pay attentions and control behavior, disability to communicate and understands language, unable to relate to others, delay in development processes such as motor, social, thinking

skills and language, inability to learn, inability to maintain social relationship with others and depressions.

2.3 Characteristic of special-needs children

According to Kennedy K. (2011), special-needs children usually have behavioral problem due to deficiency that they have. They usually communicate by using a different form of behavior. Normally, if they have problem to tell what they need or want by using language, they tend to communicate in form of tantrums, self-injuries, aggressions or other problematic behaviors. These children do not know how to feel embarrassed or guilty, as they do not understand the social situation.

Special-needs children have deficiency in cognitive functions and learning styles. The characteristic of these children include, difficulty in memorizing information, slow learning rates, short span of attention and lack of motivation. (Heward, 2014)

2.3.1 Social Development

It is hard for special-needs children to make and sustain friendships and personal relationships. They have unusual and inappropiate behaviors, lack of language development and restricted cognitive processing skills that may impact how they interact with others. It is hard for someone who are not a professional staffs or professional educator to try to get to know them. (Heward, 2014)

2.3.2 Slow learning rate and repetitive behavior

Those special-needs children tend to stimulate every singe movement in their mind and had difficulties in understanding the information but, once they grasp the information, they tend to repeat doing it and the therapists would have a hard time teaching them to learn another information (Lecavalier et al., 2006). Special-needs children usually have a slower rate of acquiring new information than normal children. In order to have a correct

responds without assistance, quite a number of practice or instruction is needed. They learn slowly and in order to match their pace, the instructors need to slow down (Miller, Hall, & Heward, 1995).

2.3.3 Difficulty in sustaining attention

The special-needs children have problems to joining the appropriate features of the task and might focus on other distracting stimuli instead. They often have problems in sustaining focus to the learning process (Zeaman & House, 1979). The problem contributes to the difficulties in gathering, memorizing and generalizing new knowledge and skills. The complexity and the difficulty of the task can be increased gradually after directing the children' attention. The sustained attention will improve as they experiences success.

2.3.4 Lack in motivation

Special-needs children usually have lack of interest in learning or solving tasks (Switzky, 1997). They also developed learned helplessness due to experiencing repeated failures and they tend to expect failure no matter how hard they try then, they tend to set a low expectation of themselves and don't try hard anymore. When they get a hard problem or task to be solved, they quickly give up and turn to others to help them. Some of the special also have outer-directness which they rely on other assistance or solutions and distrust their own responses. Due to repeated failures, they tend to depend on others as they have lack of motivation (Bybee & Zigler, 1998).

2.3.5 Difficulty in memorizing

The special-needs children usually have problems in remembering information. The more critical the impairment, the more critical the memory deficiency is. Research done shows that the children have difficulties in absorbing information in the short term-memory that is the capability to recall and use the information gained in a few seconds

to a few hours earlier (Bray, Fletcher, & Turner, 1997). Special-needs children usually require more time than other normal children thus they have difficulty in handling large amount of information at one time. (Merrill, 1990) However, once these children grasp the information, they retained the information as well as a normal person (Belmont, 1966; Ellis, 1963).

2.4 Social skills

Social skills are defined as the capability to act according to the social expectations (Pati et al., 1996). Hurlock (1967) states that socialization involves three processes that are to learn how to act in a socially accepted ways play an accepted social function and the formation of social attitudes. These special-needs children perform with a restricted ability compared to normal children due to low intelligence growth. Thus, affecting their social functioning. Environment where a child grows is one of the important parts in improving social skills. According to Pati et al., (1996), if the severity of the special-needs children increase, the social development decrease.

2.5 Successful special-needs people

According to Temple Grandin's bibliography (2015), Temple Grandin was born in 29 August 1947 and diagnosed with Autism in 1950. She was placed in a structured nursery school. Grandin's mother hired a therapist who will spend hours teaching speech therapy as suggested by her doctor via playing turns-based games with Grandin and her sister.

Grandin starts to talk and making progress at the age of four. She was called tape recorder because she would do things repeatedly and were teased during her middle and high school. She graduated from Hampshire Country School, a boarding school for gifted children in 1966 and in 1970 she earned her bachelor's degree in Psychology from Franklin Pierce College, master's degree from Arizona State University in Animal Science and doctorate degree from University of Illinois in Animal Science.

She is now a bestselling author, livestock industry consultant on animal behavior and an Animal Science doctor and professor at Colorado State University. Grandin also invented a squeeze machine to keep hypersensitive people calm and also noted for her work in Autism advocacy.

FIGURE 2.1 Picture of Mary Temple Grandin

2.6 Turn-taking

Oxford Dictionary define turn as an obligation or chance to do something alternately to each of a number of people. Shaul (n.d.) states that it is quite hard for children with special-needs to master taking turns due to the theory of mind deficiency as they are not unable to predict how other person feels to be interrupted while playing video games or given the last turn in playing video games. They also are unable to look forward to positive social outcome such as allowing others to go ahead of them for example talking first in the discussion or play the games first.

2.7 Artificial Intelligence

According to Oxford Dictionary, Artificial Intelligence refers to the ability of a computer system to perform a task that require a human intelligence such as languages translation, decision making, visual perception and speech recognition. Jones (2008) states that Artificial Intelligence is where computational devices and computational models can duplicate intelligence behavior and display it. Artificial Intelligence attracts the attention of the scientist and scholars after Alan Turing, a British Mathematician published "Computer Machinery and Intelligence'. Both Jones and McCarthy agreed that Artificial Intelligence allow machines to have a human-like characteristic such as thinking, giving logical response and inference. According to Russel and Norvig (2013), the research in this field focuses on the development of algorithm that minimizes user control when the device is being used. There are several disciplines in Artificial Intelligence such as E-Commerce, Computational Biology, Machine Learning, Natural Language Processing, Computer Vision and Robotics.

2.8 Existing applications in special-needs education

There are some applications has been created to cater the problem of having false-belief tasks difficulty and do not establish social behavior.

2.8.1 Turn Taker

FIGURE 2.2 Turn-taker

Turn taker is an Apple application that teaches taking turns and good sharing behavior via an illustrated social stories, prompting tool and customizable sharing timer. It uses visual and audio to ease turn taking and sharing in special-needs children. A simple social story that converses suitable gameplay is also included. With instructions and prompts, they can improve their play skills. It is a simple intervention designed to target the social skills. A therapists or caregivers are able to set the time limit for each person's turn. It makes easier for turn sharing, as it is fair with specific time allotments for each person's turn. The time limit should be set a little bit longer for the target special-needs children in the beginning in order to reduce the anxiety when it is not their turn. The time limit for the target's person can be reduced until both people's time is equal once the target person mastered the turn-taking activities. (Touch Autism, n.d)

2.8.2 Robota

FIGURE 2.3 Robota

Robota is a doll shape robot that learns, imitate and communicate. The robot can copy the arm and head movement of a demonstrator using a simple phototaxis behavior. It allows learning of time series controlled by Dynamical Recurrent Associative Memory

Architecture or known as DRAMA. The special-needs children can teach the robot labeling it's body part using words and simple action sequence. It has three motors, to move the arms and the head. It also has a LEGO sound emitter in order to stimulate a crying sound. It has five touch sensors in the hands and mouth and under the feet and it also has tilt sensor that helps to measure the body's vertical inclination and four infrareds detector, which consist of emitter and receptor. A simple communication system that consists of two keyboard and a loudspeaker is also provided. In order to record sounds, words or sentences, a pocket recorder is used. (Billard et al, n.d)

2.8.3 Keepon

FIGURE 2. 4 Keepon

Keepon is a snowman-like dancing robot that is developed to perform intentional communication and emotional communication with special-needs children. It has two 120 degrees wide-angled camera as the eyes and a microphone as the nose. It has a gimbal and four wires in the lower part of the body and it is made from silicon rubber, which actually can deform its body. Keepon is designed to grab the rhythm from the

movement of the person rather than the audio. The robot actually does not respond to the sounds but it responds to the movement. Rhythmic movement and action is generated autonomously but an operator guides the general direction of attention. It is believed that dancing as the main module of Keepon can help to improve non-verbal communication between special-needs children. (Michalowski M. P. et al, n.d)

2.8.4 NAO

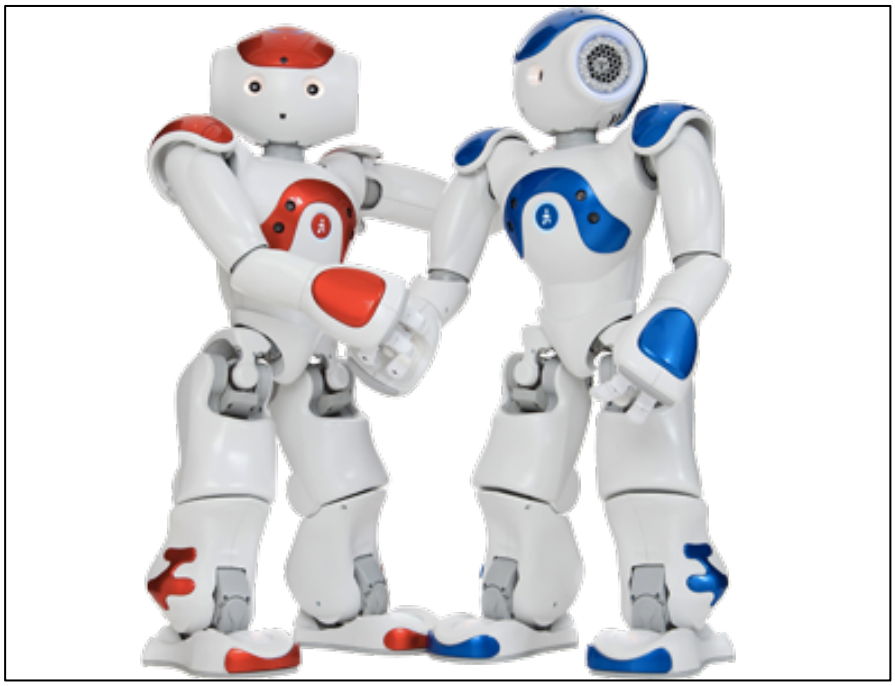

FIGURE 2.5 NAO Humanoid robot

NAO robot is equipped with a set of sensors. It has cameras embedded to track the user's location. It is also equipped with speakers and microphone to interact verbally with human. It also has several motors that help NAO to move smoothly. It can converse in simple sentences as it only has a processing power limited to simple conversation. It has fluid motor joins and sing to grab the special-needs children' attention. It also have face and voice recognition function where it can store and recognized users' face and voice in its local memory (Shamsuddin, et al., 2012).

2.9 Summary

Special-needs children cannot digest knowledge well in their education. In order to analyze the teaching method of the devices, various researches has been carried out on the existing system. The research done is summarize in Table 2.1.

TABLE 2.1 Existing applications

	Related Works	Voice Processing	Visual Processing	Ability to react to action	Realistic human appearances	Visually engaging	Toddler size	Ability to move small object	Price
1	Robota (Billard et al, n.d)	Yes	Yes	Yes	Yes	Yes	Yes	No	N/A
2	Keepon (Michalowski M. P. et al, n.d)	No	No	Yes	No	Yes	No	No	$159.00
3	Turn-taker (Turn-taker, n.d.)	No	No	No	No	Yes	No	No	$4.99
4	NAO (Shamsuddin, et al., 2012).	Yes	Yes	Yes	Yes	Yes	Yes	Yes	$7990.00

A robotic module called SOCIABOTS using a NAO humanoid robot that will adapts the ability to react and communicate with special-needs children is proposed from the literature cited here. The NAO robot price is quite expensive but, it has all the required functions and suitable for special-needs children. Besides that, by using NAO robot, a various robotic module can be designed rather than other robots that already have a specific module, for example, Keepon that only dance. The target user of the SOCIABOTS is the special-needs children, that require a simple face format and not too realistic in order to sustain their focus and avoid overloading of information.

CHAPTER 3
METHODOLOGY

3.1 Introduction

The methodology used for this project is further discussed in this chapter. Two main groups of methodology discussed are the development methodology or known as the System Life Cycle Development (SDLC) and the research methodology. The Rapid Application Development (RAD) methodology is chosen as the development method and qualitative research methodology as the research methodology.

3.2 Development Methodology

The development methodology picked is the RAD method that has been chosen for this project. This method is a method that emphasizes more on development and put less emphasis on planning tasks. This methods focus on the need of regulating requirements as the project progresses in reaction to the knowledge gained which causes this method to use prototypes in place of design specifications. The testing, deployment phase and prototyping phase took place upon reaching the completion of the requirement-planning phase. The method is suitable for deployment as it has a task list and work breakdown structure designed for speed, as the time provided to complete the project from scratch is limited to only 28 weeks that equivalent to 7 months (Wikipedia, n.d.). The RAD methodology is illustrated in figure below.

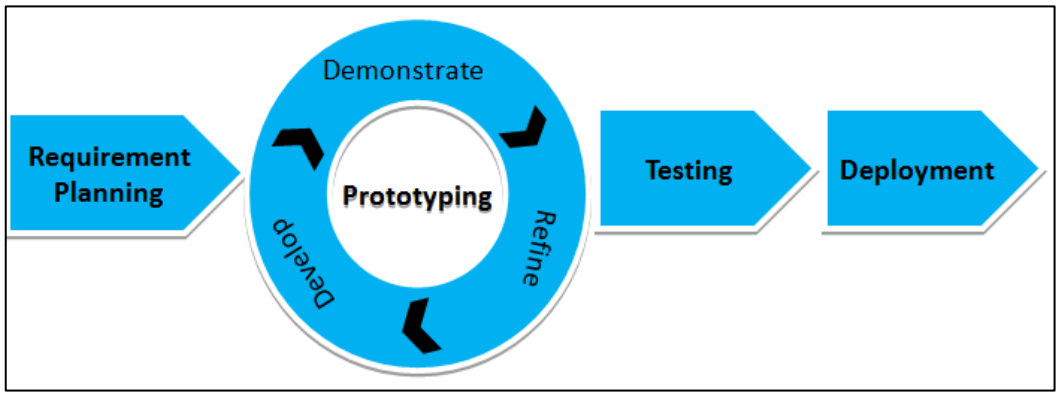

FIGURE 3.1 The RAD Model

The development and the integration of the module are done concurrently to make ensure fast product delivery. It is easier to assimilate changes within the development processes, as there is no detailed pre-planning. There are four main phases of project's activities that are requirement planning phase, prototyping phase, testing phase and deployment phase.

3.2.1 Requirement Planning Phase

The submission of project title and project summary agreed by proposed Supervisor to FYP 1 coordinator took place in the first week of FYP 1. The assignment of Supervisor took place in the second week of FYP 1. A schedule for the tasks need to be done is developed to keep on the right track so that the project can be completed within the timeframe. All the requirements for the project are identified during the planning phase. The Gantt chart is shown below.

TABLE 3.1 Gantt chart for FYP 1 and FYP 2

Task	Duration	Weeks																										
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Requirement Planning Phase																													
Identification of Problem	1 week																												
Study on the Project Background	1 week																												
Define Objective of the Project	1 week																												
Define Scope and Limitation	1 week																												
Preliminary Research	1 week																												
Literature Review																													
Selection of Tools	1 week																												
Submission of Extended Proposal																													
Prototyping Phase																													
Designing the Architecture of the Module	2 weeks																												
Construct Activity Diagram	1 week																												
Define the Function of the Components	1 week																												
Proposal Defense	1 week																												
Submission of Interim Report	4 weeks																												
Build the Module	4 weeks																												
Testing Phase																													
Field Testing	2 weeks																												
Progress Report Submission	3 weeks																												
Improvement of the Module	2 weeks																												
Pre-SEDEX	1 week																												
Deployment Phase																													
Viva	1 week																												
Submission of Project Dissertation	1 week																												

All requirements were identified during this requirement-planning phase. A preliminary visit to special education school, Sekolah Kebangsaan Sultan Yussuf in Batu Gajah, Perak on Wednesday, 27th May 2015 for two hours from 7.00 AM to 9.00 AM for was done during this phase. The objective of the preliminary visit is to gather the information, analyze the behavior of the special kids and identify the current methods used by the teachers to teach taking turns and sharing. The data is collected through interviews, surveys and questionnaires. There are five students involved.

The outcome of the questionnaires and the surveys were classified and analyzed. Journals and other dependable sources on the current existing systems were also critically analyzed. This analysis is useful to allow comparative study on the current mechanism used on teaching adhering taking turns and sharing as compared to the introduction of new module of teaching turn-takings and sharing to the special kids.

3.2.2 Prototyping Phase

The prototyping phase was initiated with the design phase, a phase where the integration between hardware and software were put together. The sensors used were recognized, and the architecture of the teaching module was outlined. The workflows of the actions and activities were shown via graphical representation of the activity diagram. The sensors were identified and the SOCIABOT was designed.

The module is built using NAO humanoid robot. The development of the module involves the programming of the functionality of the robot using the Choreographe software. The program is transferred to the NAO robot using wireless connection or a USB cable.

3.2.3 Testing Phase

The completed constructed module will be tested to evaluate the performance of the robot. The whole robot will be tested as one whole application via field-testing and the

evaluation based on observation will be recorded. Feedbacks on the limitations of the robots will be evaluated in order to upgrade and improve the module of the robot later on.

3.2.4 Deployment Phase

This phase will be the last stage after all the testing activities were conducted based on Rapid Application Development (RAD) model. The results from the testing activities and the improvement of the prototype module, SOCIABOT will be ready to be used by teachers and the special kids.

3.3 Research Methodology

The research methodology that has been employed is qualitative research method. Questionnaires and observations are used as the medium to gather more information.

3.3.1 Questionnaires

A survey is conducted by the distribution of questionnaires. The respondents are the visitors for Meet UTP event @ 2015 Formula 1 PETRONAS Malaysia Grand Prix Showcase on 21st March 2015 until 29th March 2015 at Esplanade KLCC, Kuala Lumpur. A live demonstration of the NAO is performed before the questionnaires are distributed. There were 58 respondents involved and they come from different countries, states and regions. The objective of the questionnaires is to analyze whether NAO robot is suitable for kids. The questions also tested their knowledge on the use of robots in the therapy of special-needs children.

FIGURE 3.2 NAO and a laptop prepared for the demo and online survey

FIGURE 3.3 NAO demonstration at MEET UTP @ 2015 Formula 1 PETRONAS Malaysia Grand Prix Showcase

3.3.2 Observations

A preliminary visit to special school is conducted at Sekolah Kebangsaan Sultan Yussuf, located in Batu Gajah, Perak on 27th May 2015. The aim is to collect data and information related to the behavior of the special-need children and current approaches used by teachers to teach the students to take turns and share things. Based on the observation from the visit, currently teachers are using flat shapes with holes to teach students on social behavior. From the visit, the best possible module can be designed to assist the children in their process of socializing. Journals, research papers and other reliable sources are critically analyzed to identify current existing applications and approaches for improving social interaction between children with special-need. Demonstrations during Meet UTP @ 2015 Formula 1 PETRONAS Malaysia Grand Prix

Showcase at Esplanade KLCC were also conducted to analyze the children' reaction towards robots.

FIGURE 3.4 Interview and observation session with Ms. Ibtisam, special education teacher in SK Sultan Yussuf

FIGURE 3.5 Current teaching aids for object recognition module used by teachers at SK Sultan Yussuf

3.3.1 Proposed Framework

The module's architecture is built for special needs children. This module is concentrating on helping special needs children learning to take turns and share things effectively. Therefore, the module is emphasizing on object recognition as the proposed learning method and simplicity so that it is easier for the children to understand the instructions. The overview and the flow of the system are shown below.

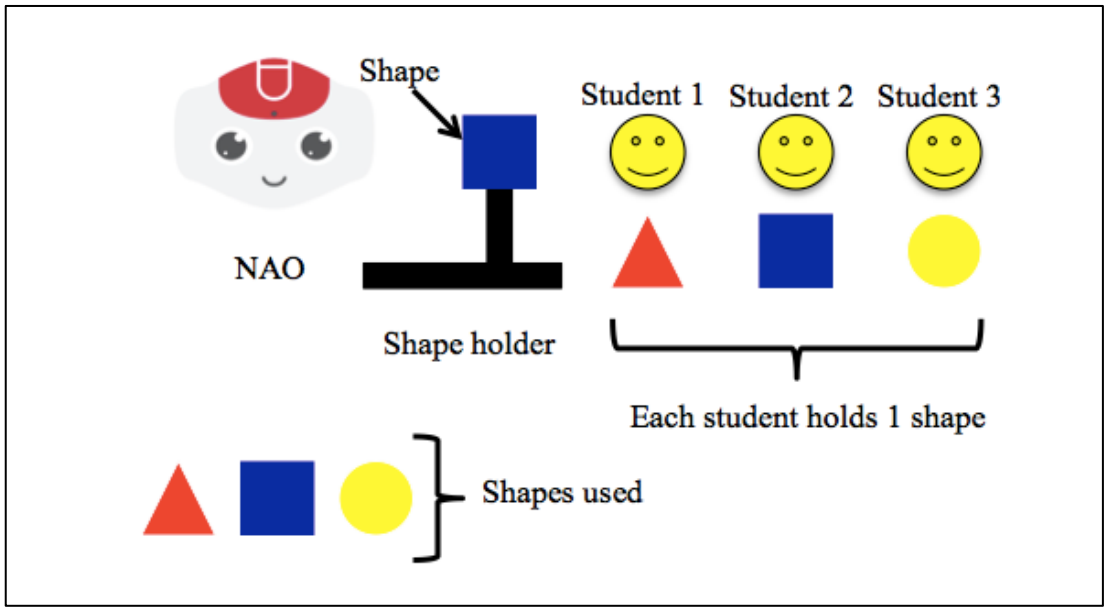

FIGURE 3.6 Overview of how the system works

There will be 3 students per session. Each student will be given a specific shape. For example, Student 1 will get a triangle, Student 2 gets the rectangle and Student 3 will get a circle. NAO starts the game and prompt the teacher to choose a random shape and put in on the shape holder. NAO will then recognize the shape by using the Visual Recognition function and tells the student what shape the Shape Holder is holding. For this example, the Shape Holder is holding a rectangle. NAO is then asks the students to put the previously said shape into the basket. The teacher will then assess the student's ability to match the shape he's holding and the shape that is mentioned by NAO. The turn-taking activity is successful when the students know whether it is their turn on not

to put the shape they are holding according to the shape that NAO mentioned. The flow of the NAO program is shown in Figure 3.7.

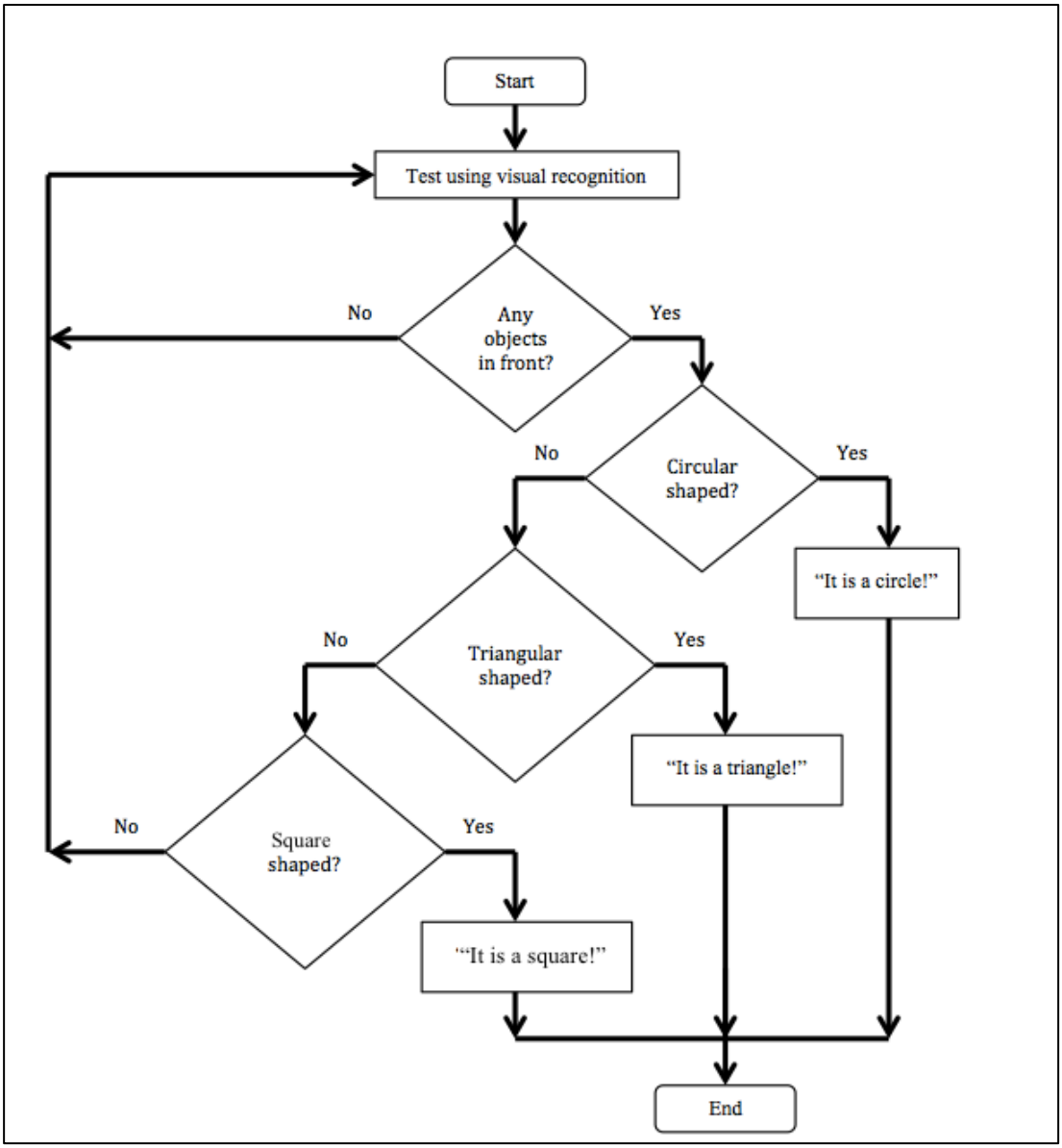

FIGURE 3.7 The flow of the recognition session

When the Vision Recognition function starts, NAO will test whether there is any object in the camera's visual range or not. If the camera detected an object, it will match the object in front of it to the shapes saved in NAO database. If the object is a circle, NAO will loudly mention that "Circle" to the students, if not, it will continue to determine

what shape it is either a square or a triangle and mention what shape it is. If none of the shapes (the circle, the square or the triangle) is detected, NAO will tell the user that the recognition session has failed, then end the session so that the user can try again.

3.3.2 Tools

The NAO humanoid provides uniform platform that enables future improvement on the robot. The components of NAO humanoid robot is shown below:

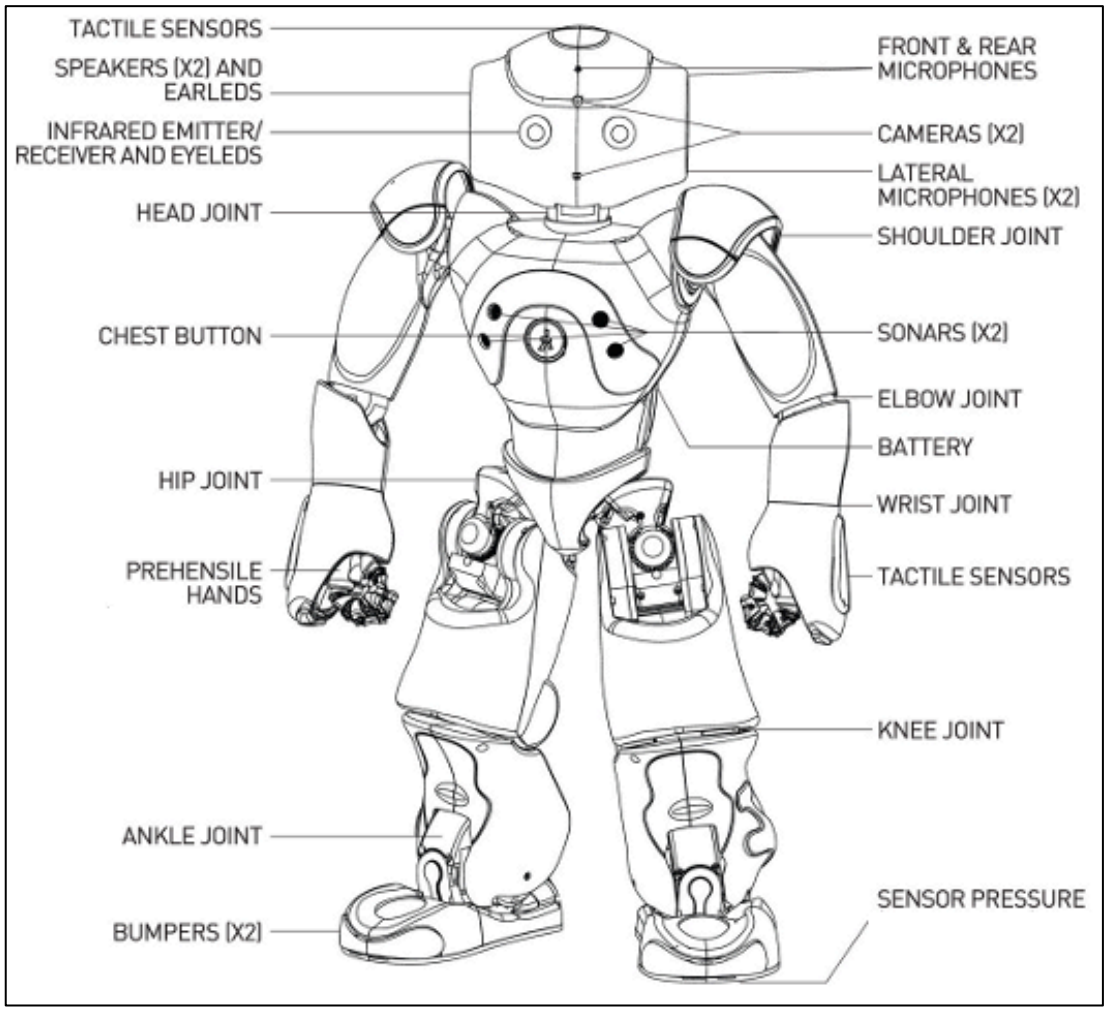

FIGURE 3.8 NAO body

Some components are described in details in Table 3.2.

TABLE 3.2 NAO components

Components	Description
Camera	See the surroundings, recognizes pre-recorded faces, images, read books and imitates. The camera on NAO's forehead scans the horizon, while the camera at mouth level scans the immediate surroundings.
Inertial measurement unit	Determine whether he is sitting down or upright
Touch sensors	Detect the touch
Directional microphones	Detects the origin of the sound, recognize and understand the sound. NAO can communicate in 19 languages using voice recognition and text-to-speech capabilities.
Sonar rangefinders	Estimate the distances to obstacles in the environment. Detection range is from 1 cm to 3 metres.
Tactile sensors	Give NAO information through touch, non-verbal communication with NAO
LED lights	Indicate the type of contact, express emotions
High-fidelity speakers	Play musicf, multilingual text-to-speech synthesis
Foot bumpers	Non-verbal communication with NAO
Prehensile hands	Graps small object, work on item exchange and turn-taking

3.4 Data Collection

In order to gather information related to the study, several methods were used for the information collection that includes the visit to Sekolah Kebangsaan Sultan Yussuf. The data collected was then further analyzed to validate the research results.

3.4.1 Pilot study in Sekolah Kebangsaan Sultan Yussuf

Due to logistic feasibility factor, Sekolah Kebangsaan Sultan Yussuf was selected for the pilot study as the location is nearby Universiti Teknologi PETRONAS (UTP) that is about 13.2 km from UTP.

Sekolah Kebangsaan Sultan Yussuf was established in 1970 as Government English School under Mr. J.H.D Oliver's management. Based on the interview with Ms. Ibtisam, there are about 63 students in Sekolah Kebangsaan Sultan Yussuf and there are currently

9 classes to accommodate these students. The average number of special students is in the range of 5 to 7 students per class.

3.4.2 Data Analysis

Interviewing the teachers in the special schools allows the process of information gathering on the current pedagogy of complying with the social rules. Interview is used as the information gathering method when it comes to human scientific research. This method was selected and used to analyze the problem faced by the teachers followed by the interpretation of the data.

CHAPTER 4
RESULTS AND DISCUSSIONS

4.1 Introduction

The outcome of the research including the surveys and the interviews are further discussed in this chapter. A visit to Sekolah Kebangsaan Sultan Yussuf to gather information for the project was carried out on 27th May 2015. Sekolah Kebangsaan Sultan Yussuf has a sub school which teaches special-needs students.

There are 63 special-needs students in Sekolah Kebangsaan Sultan Yussuf and 12 of them are diagnosed with Autism, seven of them diagnosed with down syndrome, four of them diagnosed with ADHD, 30 out of 63 are slow learner and another 10 of them are diagnosed with physical disabilities.

4.2 Qualitative Results of Observation, Interview and Survey

A visit to Sekolah Kebangsaan Sultan Yussuf as shown in Figure 4.1 below was conducted on 27th May 2015 for two hours from 7.00 AM to 9:00 AM. The main purpose of this visit is to gather information on the current way of teaching the special-needs kids to take turns and the problem faced by them in establishing social relationships.

The teachers were interviewed by using the same set of questions. There are two respondents comprising of two female teachers. The interview process is shown in Figure 4.1.

FIGURE 4.1 Interviews with Ms. Ibtisam, special education teacher in SK Sultan Yussuf

The summary of the special students in Sekolah Kebangsaan Sultan Yussuf is shown in Table 4.1.

TABLE 4.1 Summary of Autism, ADHD, slow learner and down syndrome students at SK Sultan Yussuf

Students	Gender	Level	Problems
Student 1	Male	1	Autism
Student 2	Male	1	Autism
Student 3	Male	1	Autism
Student 4	Male	1	Autism
Student 5	Male	1	Autism
Student 6	Female	1	Autism
Student 7	Female	1	Autism
Student 8	Female	1	Autism
Student 9	Male	1	Autism
Student 10	Male	1	Autism
Student 11	Male	2	Autism
Student 12	Male	4	Autism
Student 13	Male	1	Slow learner
Student 14	Male	1	Slow learner

Student 15	Male	1	Slow learner
Student 16	Male	1	Slow learner
Student 17	Male	1	Slow learner
Student 18	Male	1	Slow learner
Student 19	Female	1	Slow learner
Student 20	Male	2	Slow learner
Student 21	Male	2	Slow learner
Student 22	Male	2	Slow learner
Student 23	Male	3	Slow learner
Student 24	Male	3	Slow learner
Student 25	Male	3	Slow learner
Student 26	Male	3	Slow-learner
Student 27	Male	3	Slow learner
Student 28	Female	3	Slow learner
Student 29	Female	3	Slow learner
Student 30	Male	4	Slow learner
Student 31	Male	4	Slow learner
Student 32	Male	4	Slow learner
Student 33	Male	4	Slow learner
Student 34	Male	4	Slow learner
Student 35	Female	4	Slow learner
Student 36	Male	5	Slow learner
Student 37	Male	5	Slow learner
Student 38	Male	5	Slow learner
Student 39	Female	5	Slow learner
Student 40	Female	5	Slow learner
Student 41	Female	5	Slow learner
Student 42	Female	5	Slow learner
Student 43	Male	1	Down syndrome
Student 44	Female	1	Down syndrome
Student 45	Female	1	Down syndrome
Student 46	Female	1	Down syndrome
Student 47	Female	1	Down syndrome
Student 48	Male	2	Down syndrome
Student 49	Female	2	Down syndrome
Student 50	Male	1	ADHD
Student 51	Male	1	ADHD
Student 52	Male	4	ADHD
Student 53	Male	5	ADHD

Level 1 to 5 refers to severity. Level 5 is the most severe, and level 1 is mild.

4.2.1 Interview on the special education teachers of Sekolah Kebangsaan Sultan Yussuf

A structured interview was conducted on the teachers of the special students to find out on the problems in establishing social relationships. The interview was conducted on two special education teachers of Sekolah Kebangsaan Sultan Yussuf.

The teachers are chosen to be the respondents because they have experience in dealing with special-needs children. Studying the special-needs children' behavior during the taking turns lesson period helps to add useful function to the robot. The objective of this interview is to study the problem of the special-kids in establishing social relationship and the current pedagogy used by teachers to teach the special needs children in taking turns.

TABLE 4.2 The summary of the interviewees

Teachers	Age	Occupation	Working Experience
Ms. Noor Ibtisam Zainal Bahrin	30	Teacher	6 years
Ms. Mai Nurul Fareha	32	Teacher	7 years

The two interviewees were first asked about their opinion on what causes the special-needs children to have problems in establishing social relationships with others from their observation and experience. Both of them state that the special-needs children have problems in interacting with others as they are shy and does not have any courage to approach someone who they doesn't really know. They will only communicate with someone that they are familiar with. However, normally, if they have problem to tell what they need or want by using language, they tend to communicate in form of tantrums, self-injuries, aggressions or other problematic behaviors. (Kennedy, 2011)

The interviewees were then asked about the standard characteristic, behavior or any eccentric or abrupt action displayed by the special-needs children. The first interviewee said that when there is any unfamiliar person nearby the special-needs children they throw tantrums so that they will stay away from the special-needs children. However,

both of the interviewees state that the children will throw tantrums, cry or hitting other people for attention. According to Kennedy (2011), special-needs children usually have behavioral problem due to deficit that they have.

The interviewees are then asked about how do they usually teach the special-needs children on taking turns. The first interviewee usually asks and helps the students to line up according to their numbers. The numbers were given before the children line-up and card of numbers are used to determine the turn of the children in the line.

The second interviewee also used the same method except that she's using colored cards to determine the turn. The interviewee also states that in order to make the turn-taking activities to be interesting, she would play music box with the children. The special-needs children will sit in a circle. The teacher will play a song and passed a ball is through all of the children and the ball stops when the music stops. The person with the ball will be able to get rewards from teacher in term of time play or candies while the others will need to wait for the ball to arrive in their hands in the next round.

The interviewees were asked whether they think NAO robot is a good method to improve social behavior and the learning rate of the special-needs children. Both of them agree that NAO robot is interesting enough to attract the special-needs children' attention as it can move, dance, talk and sings. The first interviewee states that the special-needs children are more focus and attracted to learn about turn-taking activities by using the NAO robot. The second interviewee also states that NAO robot can help to improve the courage and the confidence level of special-needs children to interact with other people.

Based on a study done by Gullian (n.d), there are few requirements needed for developing a robot for special-needs kids. First, the robot must be attractive yet has a careful balance in order to avoid the kids to over-stimulate. The face should have a simple format that helps to prevent overstimulation. The appearance of the robot should not be too realistic as it may reduce the child's interest but it must also not too

mechanical to avoid the kids to be more interested in examining the components rather than communicating.

The robot should be perceived as a human but is recognized as a robot via its mechanical properties. The robot should also have a size of a human toddler. The resemblance of size will make the robot more interesting and allow the kids to be at the robot's eye-level. In order to enhance the feeling of the toddler-size robots, the robot should also have degrees of motion that is similar to a human toddler. The robots should also be able to move small objects.

4.2.2 Observation on the special student of Sekolah Kebangsaan Sultan Yussuf

The observation is mainly done on the special-needs children behavior during one of the special education class. This is to determine the suitability of the module designed with the module used in the classes and also aligned with the capabilities of the special-needs children. Teachers usually use colors and shapes in class. Teachers also gave rewards after the children accomplish or successfully performed the task.

Based on the observation on the special-needs children, they seem to have low confidence level. When the teacher asks a question, they knew the answer, but they took some time to answer the question because they were not sure whether the answer are correct.

Some of them were quite fast in grasping information but some of them are quite slow, lack of focus and require more attention rather than the others. There are some of them communicates well, either by verbal communications or non-verbal communications but there are some who need to be prompted by the teacher to communicate.

Few of them showed a little interest in the learning process, but most of them, didn't. This shows the difficulty of the teachers to retain their attention in the knowledge

sharing process and this is why SOCIABOTS will be focusing on retaining their attention to see whether improving the social skills of these special-needs children will successful or vice versa and giving out rewards after they successfully accomplished their tasks.

Figure 4.2: A special-needs child on observation

4.2.3 Survey on the teachers of Sekolah Kebangsaan Sultan Yussuf and the visitors of Meet UTP @ 2015 PETRONAS Formula 1 Grand Prix Showcase

Surveys were administered on a group of teachers and a group of public to seek their opinion on the special education and robotics. A set of questionnaires consisting of four questions had been distributed to the special education teachers of Sekolah Kebangsaan Sultan Yussuf on 27th May 2015 and the visitors of Meet UTP @2015 Formula 1 PETRONAS Grand Prix Showcase at Esplanade KLCC on 21st March until 29th March 2015.

A live demonstration on how SOCIABOTS works was performed before the questionnaires were distributed. There are two teachers and 58 public involved. The objective of the survey is to analyze whether NAO robot is suitable for special-needs children. The questions also tested their knowledge on the use of robots in the learning session in special schools.

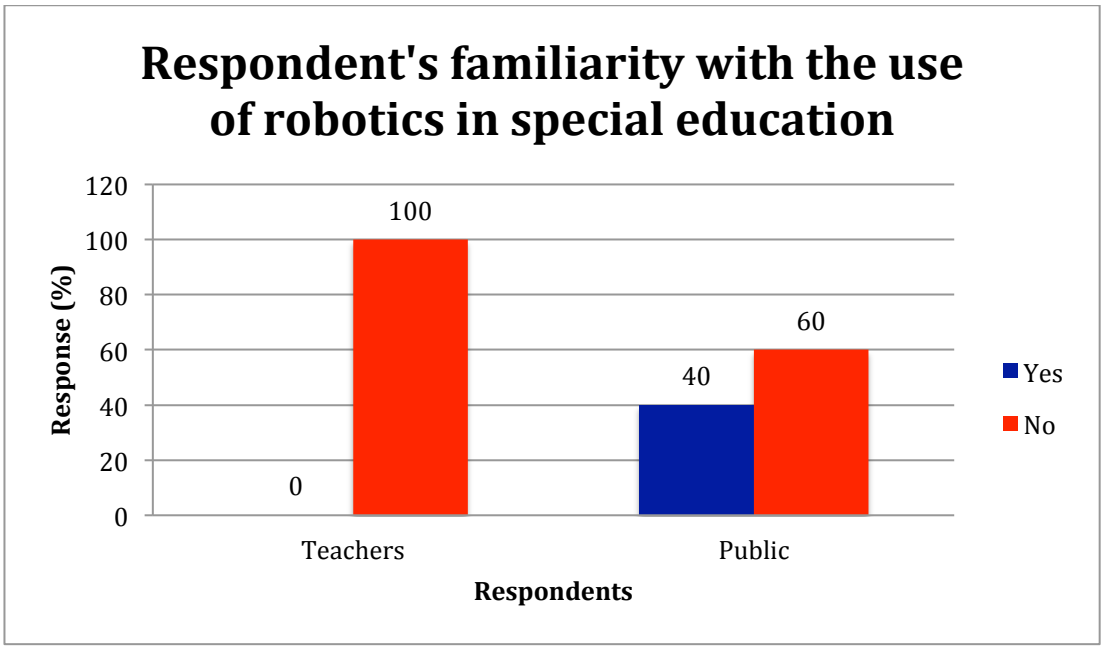

FIGURE 4.3 Respondents' familiarity with the use of robotics in special education

Based on the survey, two teachers (100%) and 35 (60%) public visitors in KLCC are unaware of the use of robotics in special education. This followed by the next question, which asked about their own experience in using robots in their learning or teaching process.

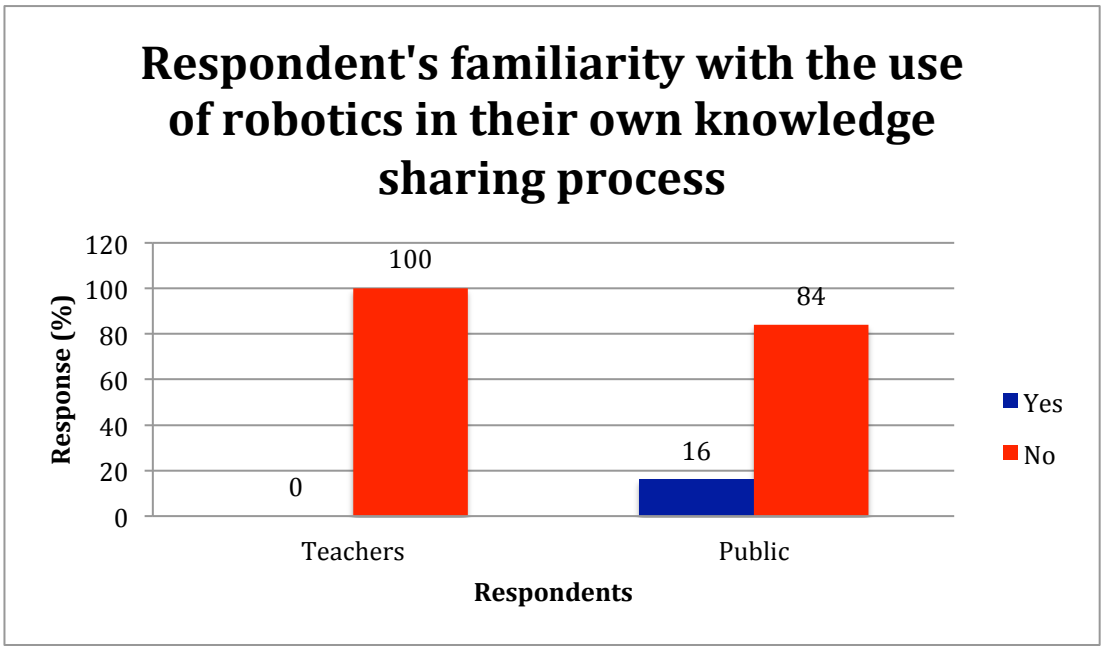

FIGURE 4.4 Respondents' familiarity with the use of robotics in special education

The two teachers (100%) and 49 public visitors (84%) hasn't used any robotic application during their own learning and teaching process thus shows that it is the main reason why most of the respondents are not aware about the use of robotic applications in special education.

Besides that, excluding the special education teachers, most of the respondents didn't encounter directly with the special-needs children or special education thus proves that they are not familiar with special education or the use of robotics in special education.

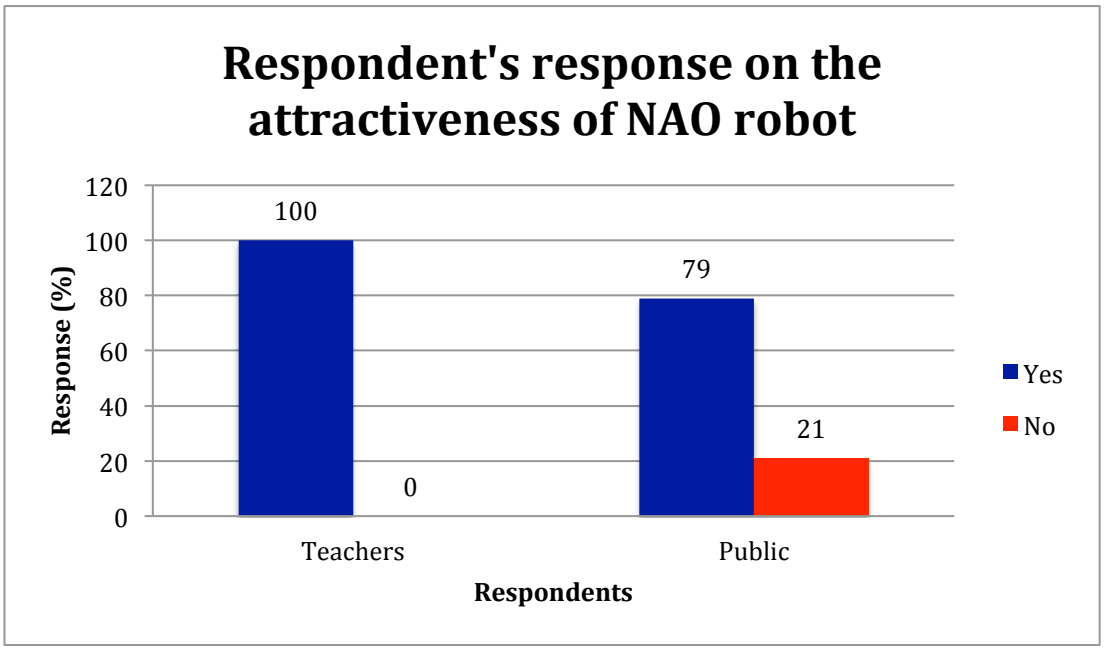

FIGURE 4.5: Respondents' response on the attractiveness of NAO robot

Most of the respondents agreed that NAO are attractive but 12 public visitors (21%) out of 58 disagree that NAO are attractive. Some of them state that they don't like the color scheme of NAO. Some of them would prefer a blue-colored NAO instead of red-colored NAO. Some of them also believe that multi-colored NAO should be better than a single-colored NAO. Some of them also state that the color is too bright for children.

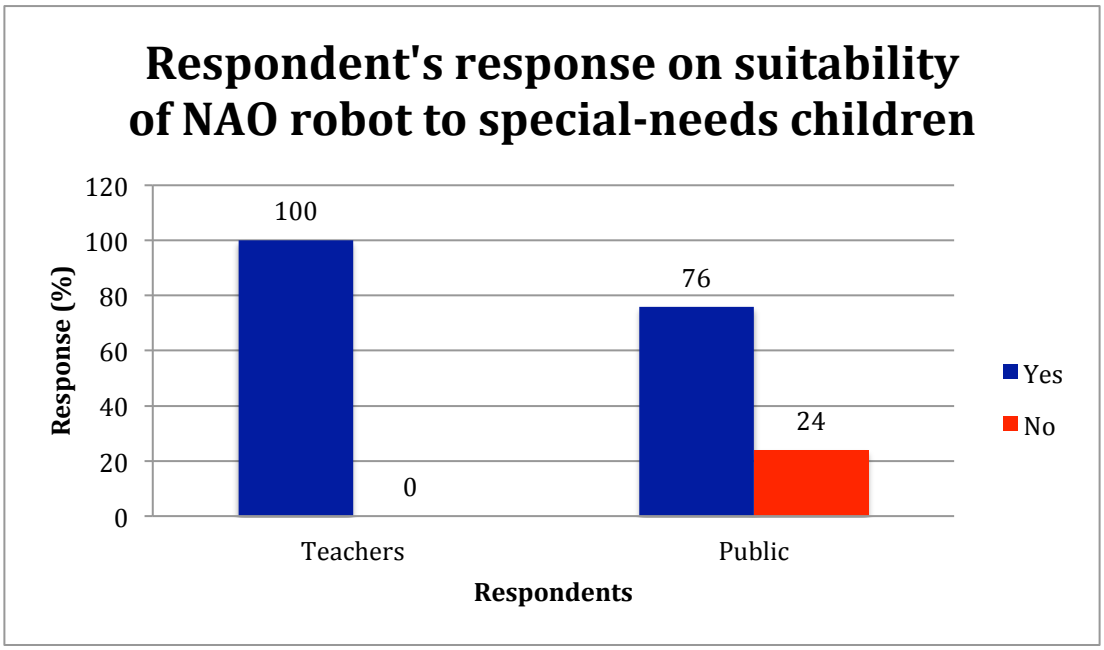

FIGURE 4.6 Respondent's response on suitability of NAO robot to special-needs children

From the survey, most of the respondents including the special-education teachers agreed that NAO robot is suitable for special-needs children while 14 out of 58 (24%) public visitors in KLCC states that NAO robot is not suitable for special needs children. The respondents disagreed because the use of robotic in special education or childhood education are not suitable for children as they think it would be dangerous for them to operate the robot by themselves. They also state that the robot should be operated with a supervision of teachers or parents.

However, the main objective of SOCIABOTS is to aid teachers, but not to replace teachers completely. The best method to teach the special-needs children is always by human intervention. Since, the robot is emotionless, it is a disadvantage for the robot to be the sole teacher as the robots cannot teaches the children with care. Besides that, the robot's body needs to be handled carefully and it's better if the teachers handle it instead of the children, as it is difficult to predict the children's behavior.

4.3 Module Design

Few designs have been developed in order to analyze which robotic module suit best to tackle the problems faced by the teachers and the special-needs children. This module is designed based on identifying shape module used by teachers by identifying which shape determine whose turn instead of numbered flash cards used by teachers that have low efficiency rate.

This prototype consists of shape recognition module which enables the teachers and the special-needs children to determine what shape it is. If triangle is detected, SOCIABOTS will announce it as a "Triangle" and the teachers will ask for the students whether one of them have the same shape with the one SOCIABOTS mentioned followed by a tactile sensor at the back of NAO's head that act as a trigger button to start dancing after the students successfully accomplished the tasks.

The benefit of this robot is that the teachers can provide a more engaging therapy while having a human-computer interaction between the special-needs children and the SOCIABOTS. The final module of SOCIABOTS developed using Choreographe is shown below.

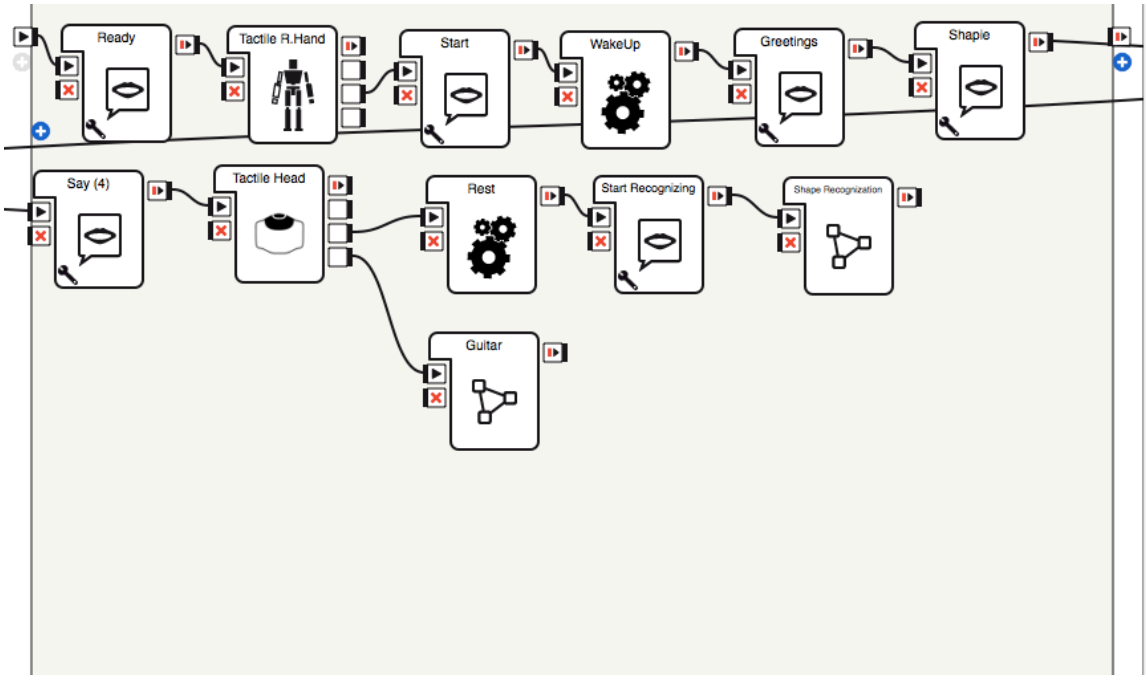

FIGURE 4.7 The final module of SOCIABOTS

When the robot starts, it first will say “I’m ready” which means the robot are booted up completely and ready to be used. Then, the teacher will touch the tactile sensor at the right hand of the robot. The robot will then stand up and greet the students. SOCIABOTS will introduce itself and ask the teacher to touch the center of his head to start the recognition game. If the teacher touches the center of his head, the robot will ask the teacher to put the cut out shapes on the shape holder. Then robot will then say that he will start recognizing and the recognition process starts. In about 20 seconds, the robot will recognize the shape and announce the shapes as triangle, square or circle.

The teacher will ask the students whether any of them have the same shape announced by the robot. If any of the students came out with the same shape, the teacher will ask the student to touch the tactile sensor at the back of the robot’s head and the robot will perform a simple dance as a reward. If any of the students come out with the wrong shape, the teacher will tell the student, that it is not her turn.

The ability of the students to recognize the shapes and their ability to determine their turn to play with the robot is assessed by the teacher. In order to make sure the learning

process is safe and engaging, the robot will only act as a teacher's aid, not as a replacement of the teacher so the design of the module already taken into account human intervention.

4.4 Performance Tests

The performance test of the module prototype was conducted in this phase to ensure the prototype can be programmed to achieve maximum optimization. The test was conducted is the Shape Recognition Test. To study the speed of the SOCIABOTS in recognizing the shape, the distance between the shape holder and the feet of NAO robot has been fixed to 30 cm. This distance is found to be the optimum distance that could give better performance

4.4.1 Shape Recognition Test

Shape Recognition is studied to make sure SOCIABOTS recognize the shapes smoothly without errors as the minimum speed as possible and to determine which background color works best. The vision recognition block was tested in this test. For this test, the background colors used are black background and white background. The speed of the robot to recognized the shapes against each background color are recorded. The test area is assumed to be 4m x 4m, where there are two fluorescent tubes. The prototype is arranged as shown in Figure 4. 8 below.

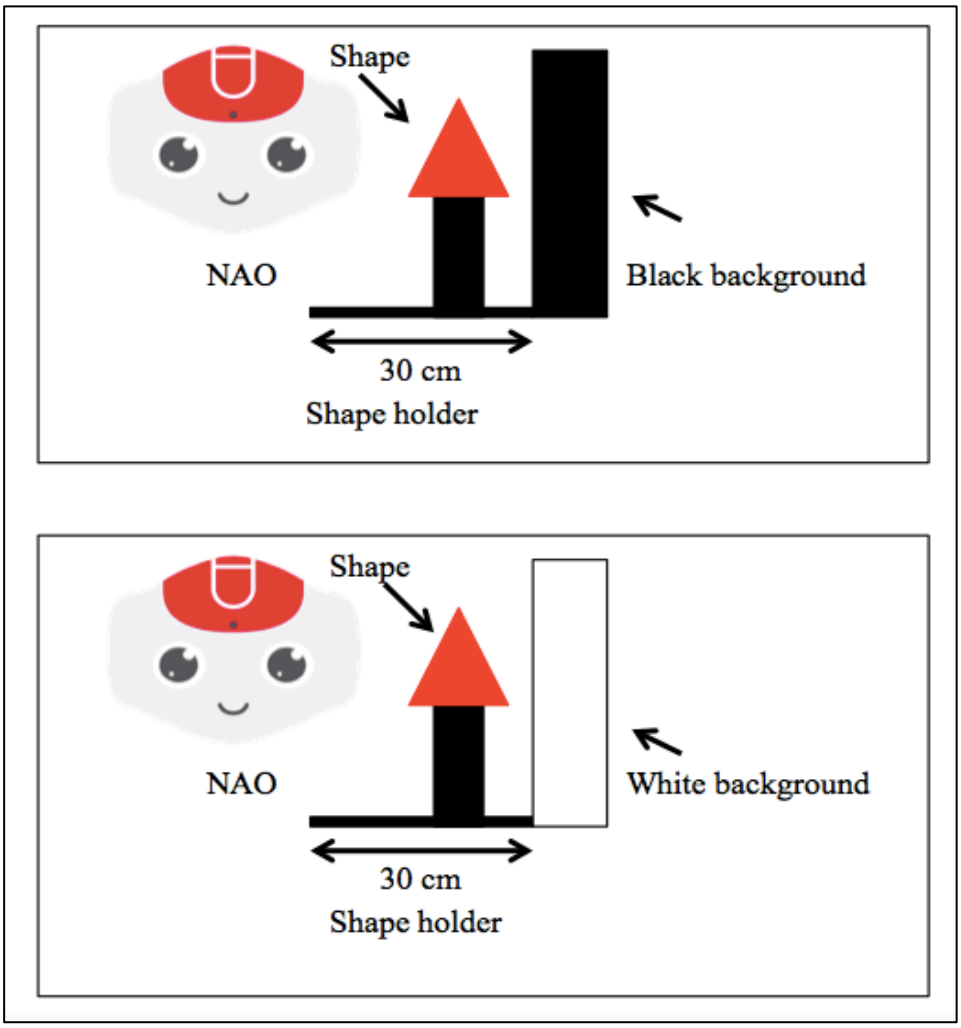

FIGURE 4.8 Arrangement of the prototype

For shape recognition, the ALVision Recognition module in Choreographe software was studied, where NAO tries to recognize the shapes that it learnt previously. The shape must be put around 30 cm from NAO. Any changes or any interference to the light intensity may cause error to the shape recognition. The NAO camera is shown below.

TABLE 4.3 Summary of the NAO's camera features

NAO Model	Version 4.0
Sensor Model	MT9M114
Focus range	30cm ~ infinity
Focus type	Fixed focus

The camera will be used for the construction of the SOCIABOTS module due to the fact that the cameras are able to recognize shapes accurately when the shapes is put within the range of 30 cm to infinity.

The test was conducted in the room with the width of 4m x 4m with two pendaflour tubes. The timer starts after the word "Now" as the robot will say "Recognition starts now." The results of the shape recognition test are shown below. The timer ends when the robot says "Triangle", "Square", "Circle" or "Failed to recognize."

TABLE 4.4 Time taken for SOCIABOTS to determine the yellow colored- circle against both background

Circle	Time taken (s)	
Number of Trials	Black background	White background
1	12.30	N/A
2	11.85	N/A
3	11.61	N/A
4	12.00	N/A
5	Failed to recognize	N/A
6	11.93	N/A
7	10.40	N/A
8	Failed to recognize	N/A
9	11.46	N/A
10	12.10	N/A

Based on the table above, SOCIABOTS cannot recognize a yellow circle on a white background due to the lighting. The image of a circle against the white background cannot be stored into the database at all after five times of trial. The circle is then tested on a black background. Based on the results, the success rate of SOCIABOTS in determining a circle on the black background is 80% with average time 11.71 seconds. The black background works better in recognizing a yellow circle.

TABLE 4.5 Time taken for SOCIABOTS to determine the blue-colored square against both background

Square	Time taken (s)	
Number of Trials	Black background	White background
1	13.40	12.95
2	11.58	13.40
3	13.48	12.88
4	13.05	13.35
5	12.53	12.81
6	12.35	12.28
7	12.53	Failed to recognize
8	12.58	12.91
9	12.67	13.17
10	11.93	13.54

Based on the table above, SOCIABOTS recognized the blue colored square against the black background with 100% success rate and average time of 12.61 seconds. For the white background, SOCIABOTS recognized the square against the white background with 90% success rate with average time of 11.59 seconds. Thus, it shows that SOCIABOTS recognize a square better, with a black background but with a longer time taken rather than a white background. SOCIABOTS works better with black background focusing on the success rate and accuracy rather than the time taken for it to recognize the shape.

TABLE 4.6 Time taken for SOCIABOTS to determine the red-colored triangle against both background

Triangle	Time taken (s)	
Number of Trials	Black background	White background
1	18.23	Failed to recognize
2	14.10	13.40
3	12.65	12.15
4	13.73	Failed to recognize
5	19.20	17.63
6	14.86	18.01
7	11.94	12.81
8	Failed to recognize	18.91
9	13.75	24.08
10	12.42	22.81

Based on the table above, the SOCIABOTS recognize the triangle on the black background with a success rate of 90% with 14.54 seconds average time while SOCIABOTS recognize the triangle with a success rate of 80% with average time of 17.50 seconds. SOCIABOTS recognize triangle better and faster on the black background.

From the results, SOCIABOTS recognize circle better on black background, recognize square better on black background but faster on white background due to the lighting factor and recognizes triangle better and faster on the black background rather than the white background. NAO failed to recognize the shape due to the unavailability of light. It is concluded that, SOCIABOTS works better with the black background rather than the white background.

4.5 User Acceptance Test

The test was carried out with five special students of Sekolah Kebangsaan Sultan Yussuf, Batu Gajah, Perak on 3rd July 2015 from 9.00 AM to 12.00 Noon. The goal of the test is ensure that SOCIABOTS accomplish the objective of the project that are to aid the teachers in the knowledge sharing process and to educate the children on how to take turns via the shape module.

TABLE 4.7 Participants for the user acceptance test

Students	Age	Gender	Background
Student 1	11	Male	Down-syndrome
Student 2	7	Male	Autism
Student 3	9	Male	Autism
Student 4	10	Male	Hyperactive
Student 5	11	Female	Slow learner

All of the five test candidates chosen have problems in recognizing shapes and problems in taking turns. All of them have no problem in recognizing circle rather than square and triangle. Some of them have no problem in identifying their turn but they have low level of confidence, afraid to try and afraid they are wrong. According to Bybee and Zigler (1998), these special-needs children developed learned helplessness, due to their experience of repeated failures. They tend to rely on assistance and distrust their own responses and have lack of motivation.

The test was conducted in two sessions, the first session is by using the current pedagogy, numbered flash cards and the second session is by using SOCIABOTS. The tests are shown as in figures below.

FIGURE 4.9 The numbered flash cards method

The teacher will give numbered flash cards to each of the student. Each of the students will receive one card. The teacher then asks for the student with number 1 on the card. The student will flash the card to the teacher, and if it's correct, then, the teacher will ask the student to come in front of the class and queue and repeat the process with the student with numbered flash card of 2 until 5.

FIGURE 4.10 The SOCIABOTS method

From the above figures, Figure 4.9 shows that the current pedagogy was employing the numbered flash card to teach the students while in Figure 4.10 SOCIABOTS was employed. The first hour of the test was to educate the children by using the numbered flash cards. The teacher showed each of the number on the flash card and tell then, which number goes first while the children have to recapitulate every shown cards and then were asked to queue in front of the class according to their respective numbers. After that, another hour was spent on SOCIABOTS. The teacher touched the center of robot's head; the robot asked the teacher to put the cut out shapes on the shape holder. Then robot then said that he will start recognizing and the recognition process starts. In about 20 seconds, the robot recognized the shape and announced the shapes as triangle, square or circle. The teacher will ask the students whether any of them have the same shape announced by the robot. If any of the students came out with the same shape, the teacher will ask the student to touch the tactile sensor at the back of the robot's head and the robot will perform a simple dance as a reward. If any of the students come out with the wrong shape, the teacher will tell the student, that it is not his or her turn. The ability of the students to recognize the shapes and their ability to determine their turn to play with the robot is assessed by the teacher in term of time. The results was observed and recorded.

4.5.1 Test Results

The test comprising of the current pedagogy and the SOCIABOTS have been observed and the results of both test are compared. The results are as in figures below.

4.5.1.1 Attention test

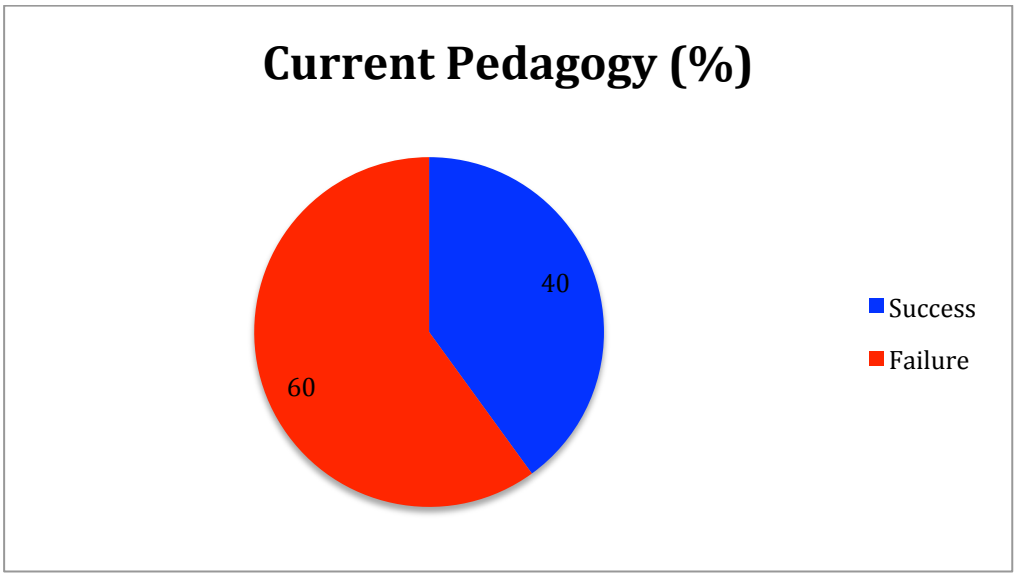

Figure 4.11 Current pedagogy's attention test result

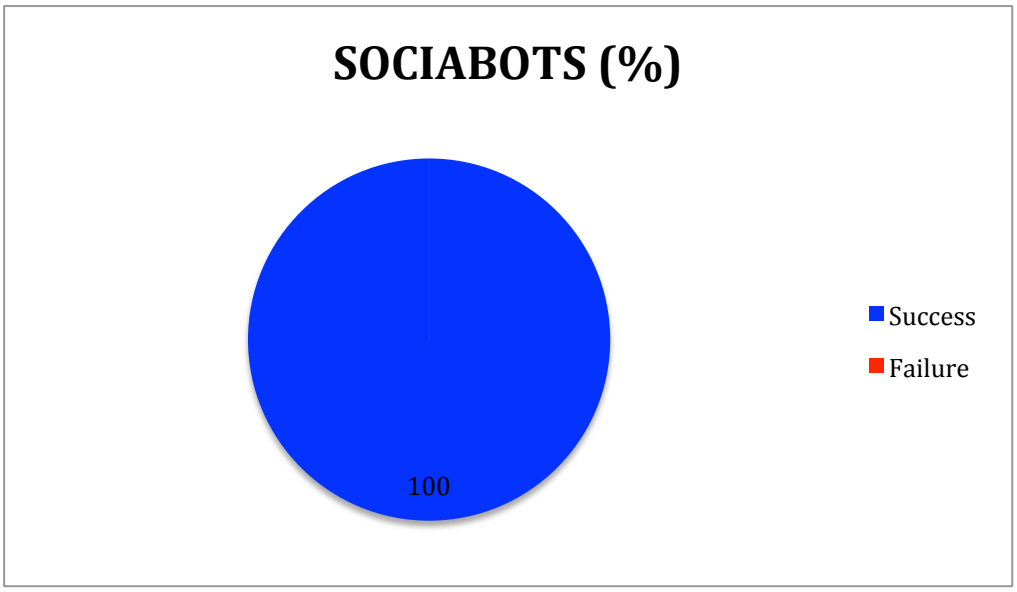

FIGURE 4.12 SOCIABOTS's attention test result

Based on the figures above, it can be concluded that SOCIABOTS attracts the special-needs children better than the current pedagogy used. Thorough observation and comprehensive score recording by each of the method determine the results. The test was conducted by observing all five students and how they pay their attention to the teacher and the SOCIABOTS. By using the current pedagogy, two out of five students pay their attention to the teacher while by using SOCIABOTS to aid the teacher; all five students pay their attention to the teacher.

4.5.1.2 Comprehension test

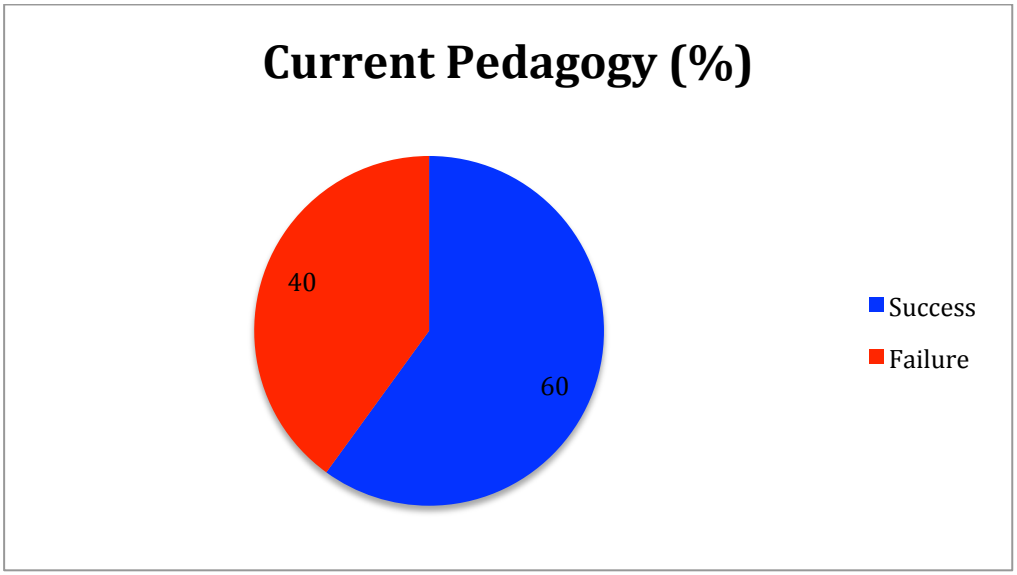

FIGURE 4.13 Current pedagogy's comprehension test results

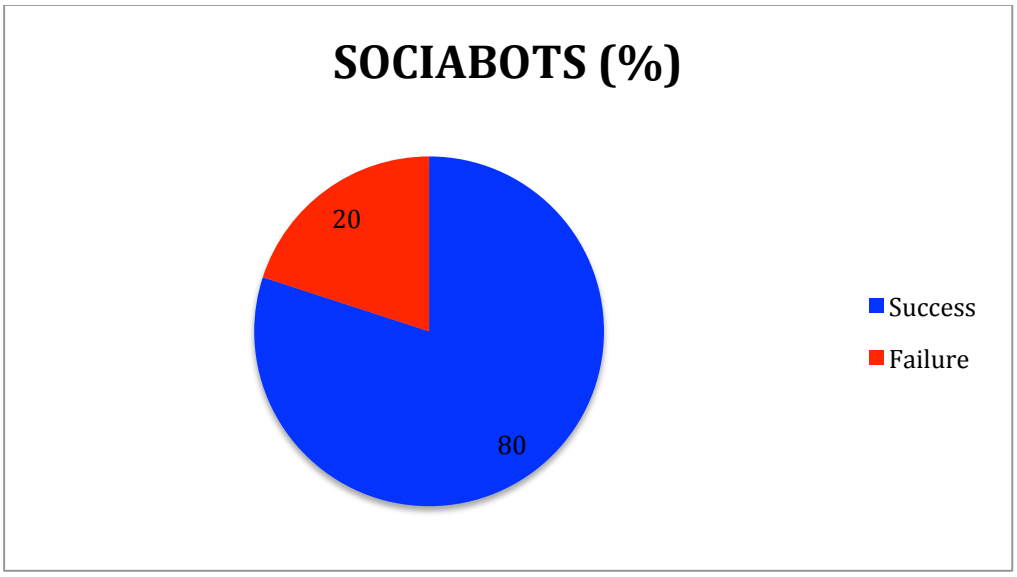

FIGURE 4.14 SOCIABOTS's comprehension test results

Based on the figures above, it can be concluded that with the aid of SOCIABOTS special-needs children comprehend better than the current pedagogy used. Thorough observation and comprehensive score recording by each of the method determine the results. The test was conducted by observing all five students and how they answer the

teacher's question, with and without SOCIABOTS. By using the current pedagogy, three out of five students can understand and answer the teacher's question correctly while with the use of SOCIABOTS to aid the teacher; four out of five students can answer the teacher's question correctly.

4.5.1.2 Confidence test

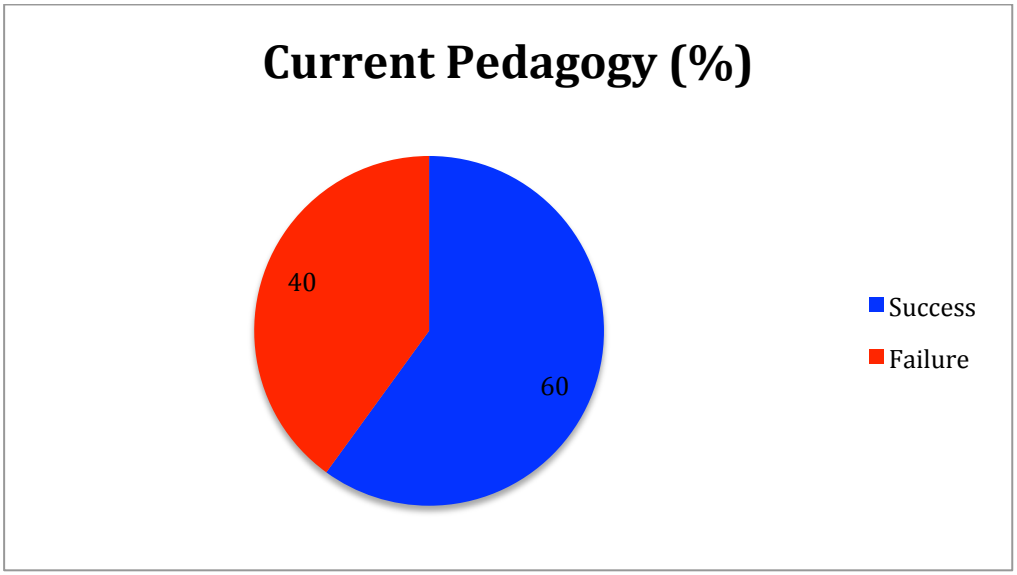

FIGURE 4.15 Current pedagogy's confidence test results

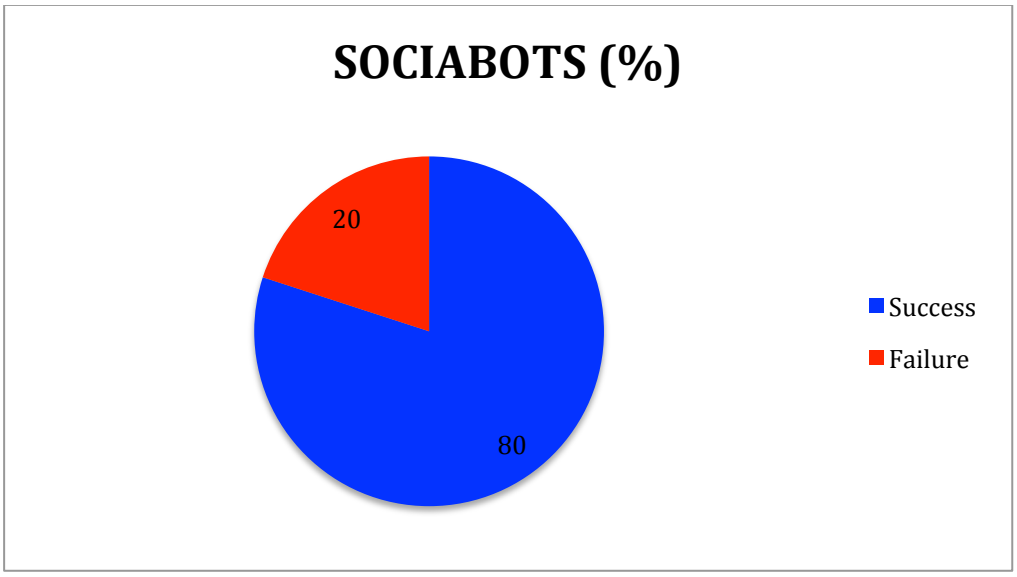

FIGURE 4.16 SOCIABOTS's confidence test results

TABLE 4.8 Time taken for the students to answer the teacher's questions

Students	Current Pedagogy	SOCIABOTS
	Time Taken (s)	Time Taken (s)
Student 1	26.4	8.35
Student 2	10.12	3.53
Student 3	15.4	10.98
Student 4	20.0	7.20
Student 5	16.8	7.86

Based on the figures above, it can be concluded that with the aid of SOCIABOTS special-needs children comprehend better than the current pedagogy used. Thorough observation and comprehensive score recording by each of the method determine the results. The test was conducted by observing all five students and how confidence the students in answering the teacher's question by recording and analyzing their time taken to answer the teachers question, with and without SOCIABOTS. By using the current pedagogy, three out of five students can understand and confidently, answer the teacher's question correctly while with the use of SOCIABOTS to aid the teacher; four out of five students can confidently answer the teacher's question correctly with a shorter time.

SOCIABOTS has higher rate of success compared to the current pedagogy used by the teachers because the robot are more attractive compared to the numbered flash cards as it can move, dance and sing. It can captivate the student's attention and maintain their focus for a longer time compared to the numbered flash cards. Thus, improving the comprehension level, confidence level and attention level of the students.

4.6 Summary

This chapter explained briefly on the outcomes of the research that was carried out in the special school and the survey that was carried out on the public against the survey that was carried out on the teachers of the special school. This is to study the problem faced by the special-needs children and the problem faced by the special education teachers in the teaching and learning. Results of field tests are documented to show the need of

having SOCIABOTS in the knowledge sharing. Interview was done on the special education teachers in Sekolah Kebangsaan Sultan Yussuf followed by an observation in the same school to observe the characteristic of the special-needs children and their problems in establishing social relationship. A set of questionnaires were distributed to the visitors of MEET UTP @ 2015 Formula 1 PETRONAS Grand Prix at Esplanade KLCC to get public opinion on the suitability of NAO and their awareness on the use of robotic application in special education and the results were compared to the same set of questionnaires distributed to a group of special education teachers in SK Sultan Yussuf. Other than these, performance test was conducted to test the performance of the vision recognition of the robot and the user acceptance test was conducted to test whether the developed module is suitable for the special-needs children and caters both teachers and the children's needs.

CHAPTER 5
CONCLUSION

5.1 Introduction

Even though it is important to include human-intervention in the special-needs children in their turn-taking lessons, failure to attract the children using existing pedagogy used by the teachers may cause slower brain development. In some scenario in this phenomenon, it may result in total shroud of the special-needs children' future due to permanent mental breakdown. This project emphasized on the study of problem faced by special-needs children in taking turns and establishing social behavior.

5.2 Achieved Objectives

Several objectives of the study that need to be accomplished by the end of this project, are identified, which are:

Objective 1: To study the awareness of the public on the teaching and learning methods for special education.

This objective has been achieved through surveys. Two surveys have been done to research on the public awareness on the use of robotics in special education and the suitability of NAO robot for children. A survey on 62 visitors of Meet UTP @ 2015 Formula 1 PETRONAS Grand Prix Showcase at Esplanade KLCC has been carried out and compared against a survey on 10 special education teachers of Sekolah Kebangsaan Sultan Yussuf to seek their opinion on the suitability of NAO robot and their awareness on the use of robotic applications in special education.

Objective 2: To study the problem of special-needs children in establishing social behavior.

The second objective has been achieved through a visit to Sekolah Kebangsaan Sultan Yussuf in Batu Gajah on 27th May 2015 from 7.00 AM to 9.00 AM. An observation was done to observe the problems faced by the special-needs children and the problems faced by the teachers in term of teaching and learning. The observation also focuses on how the special-needs children react towards the current pedagogy used to see the degree of efficiency of the current pedagogy used by the teachers. An interview with the special education teachers was conducted to gather more information on what causes these children to have problems in establishing social relationship, standard characteristic or behavior of these children, the current pedagogy the teachers used to teach turn-taking and whether NAO is suitable for the special-needs children.

Objective 3: To develop a robotic module that can help special-needs children to improve their social skills through games.

SOCIABOTS has been developed into a module that covers the three main criteria which the module emphasizes game-based activities by playing who hold the same shape with NAO, giving out reward by dancing after the task was successfully done and the module used a usable language which the sentences used by the robot are three words maximum.

Objective 4: To test the developed prototype on real special-needs children against the current teaching method.

SOCIABOTS prototype module has been tested on the special-needs children of Sekolah Kebangsaan Sultan Yussuf on 3rd July 2015 from 9.00 AM to 12.00 Noon where both test for current pedagogy used and robotic application has been exercised and compared. After thorough observation and a proper scoring, the results are favoring robotics

application rather than the current pedagogy as it caters both of the teachers and the special-needs children needs.

5.3 Future Works

The current scope of SOCIABOTS is to create a robotic module that emphasizes on the characteristic of the special-needs children with mild disabilities. Improvement and upgrade can be done to the robot to serve for the children with severe mental disabilities. New features such as anti-aggressive manager can be added to the robot in order to serve aggressive special-needs children. In addition to that, a cheaper and durable robot might also be a good idea so that this robotic module can help and cover a wider range of the special-needs children. Another teaching module for to improve the social skills can also be developed.

5.4 Summary

The special-needs children usually don't socialize with others due to false-belief tasks difficulty and do not establish social behavior for example, verbal initiations, turn taking, empathy and sharing. In order to tackle this problem, studies on existing robotics applications, software applications and current pedagogy used by the teachers has been recognized. However, there were the advantages and the disadvantages of each of those applications and pedagogy, giving out the opportunity to get the useful features and functionality needed for designing the SOCIABOTS module. SOCIABOTS are able to make learning turn-taking attractive to the special-needs children, followed by a reward by dancing to make the special-needs children happy with their achievement in completing tasks. This ensures that learning turn taking is interactive and attractive thus improving the social behavior of the special-needs children and their learning rates.

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APPENDICES

SOCIABots: A Robotic Approach for Special Education Children to Improve Their Socialising Skills

This questionnaire is part of a study to develop a robotic module for children with special-needs to improve their social skills. This questionnaire has two version; English and Bahasa Malaysia.

YOUR PARTICIPATION IS ESSENTIAL TO THE SUCCESS OF THIS STUDY. THANK YOU

Soal selidik ini sebahagian dari kajian untuk membangunkan modul robotik bagi kanak-kanak istimewa untuk menambahbaik kemahiran bersosial mereka. Soal selidik ini mempunyai dua versi bahasa iaitu; Bahasa Inggeris dan Bahasa Malaysia.

KERJASAMA ANDA AMAT PENTING DALAM MENJAYAKAN PENYELIDIKAN INI. TERIMA KASIH.

If you have any questions regarding this study, please contact:
Jika anda mempunyai sebarang persoalan berkaitan soal selidik ini, sila hubungi:

Nurul Husna binti Mukhtar
nurulhusnamukhtar@gmail.com

* Required

1. **1. Gender/ Jantina:** *
   Mark only one oval.

   - ◯ Male/ Lelaki
   - ◯ Female/ Perempuan

2. **2. Age/Umur:** *
   Mark only one oval.

   - ◯ < 13
   - ◯ 13 - 17
   - ◯ 18 - 24
   - ◯ 25 - 34
   - ◯ 35 - 44
   - ◯ 45 - 54
   - ◯ 55 - 64
   - ◯ 65 - 74
   - ◯ > 74

3. **3. Job/Pekerjaan** *

Mark only one oval.

- ◯ Student/Pelajar
- ◯ Educator/Pendidik
- ◯ Executives/Eksekutif
- ◯ Non-executives/Bukan Eksekutif
- ◯ Unemployed/Tidak Bekerja
- ◯ Self Employed/Bekerja Sendiri
- ◯ Other: .....

4. **4. The NAO robot's appearance is very attractive/ Penampilan robot Nao sangat menarik**

Mark only one oval.

- ◯ Yes / Ya
- ◯ No/ Tidak

5. **5. NAO robot is suitable for children/ Robot NAO sesuai untuk kanak-kanak** *

Mark only one oval.

- ◯ Yes / Ya
- ◯ No / Tidak

6. **6. Audio used are clear and understandable/ Audio yang digunakan jelas dan difahami**

Mark only one oval.

- ◯ Yes/ Ya
- ◯ No/ Tidak

7. **7. Sentences said by NAO robot is easy to understand/ Ayat yang diucapkan oleh robot NAO mudah difahami** *

Mark only one oval.

- ◯ Yes/ Ya
- ◯ No/ Tidak

8. **8. The color of NAO robot are attractive and suitable for children/ Skema warna robot NAO adalah menarik dan sesuai untuk kanak-kanak**

Mark only one oval.

- ◯ Yes/ Ya
- ◯ No/ Tidak

9. **9. I would like to use NAO robot for teaching, learning or as a social companion/ Saya ingin menggunakan robot NAO untuk pengajaran, pembelajaran atau sebagai teman sosial**

   Mark only one oval.

   - ◯ Yes/ Ya
   - ◯ No/ Tidak

10. **10. I have heard about the use of robots in special education/ Saya pernah mendengar tentang penggunaan robot dalam pendidikan khas.**

    Mark only one oval.

    - ◯ Yes/ Ya
    - ◯ No / Tidak

11. **11. I have used a robot to learn or teach/ Saya pernah menggunakan robot untuk belajar atau mengajar**

    Mark only one oval.

    - ◯ Yes/ Ya
    - ◯ No/ Tidak

12. **12. I agree that by using robots, we can improve social skills among children with special needs/ Saya bersetuju bahawa dengan penggunaan robot, kita mampu menambahbaik kemahiran bersosial antara kanak-kanak istimewa**

    Mark only one oval.

    - ◯ Yes/ Ya
    - ◯ No/ Tidak

Name :
Age :
Occupation :
Working Experience :

1. From your experience or observations, what causes the special-needs children to have problems in establishing social relationship with others?

2. From your point of view, what is social relationship? What is the standard characteristic of these special-needs children that were always displayed by them?

3. Is there any abrupt action (eccentric behaviour) from the special-needs children? If so, please state the action and clarify.

4. How do you usually teach the special-needs children to take turns?

5. Do you think NAO robot is an attractive method to improve the social behaviour and improve the learning rate of the special-needs children?

THE COPYRIGHT ACT 1987

THE COPYRIGHT REGULATIONS 1990

IN THE MATTER OF Section 42 (1) of the Copyright Act 1987.

STATUTORY DECLARATION

I, **NORSHUHANI BINTI ZAMIN (770523-086626)** of Universiti Teknologi Petronas of Bandar Seri Iskandar, 32610 Perak Darul Ridzuan, Malaysia, a Malaysia citizen of full age do hereby solemnly and sincerely declare as follows:-

1. I am the **Senior Lecturer** of **Computer Information Science** of Universiti Teknologi Petronas of Bandar Seri Iskandar, 32610 Perak Darul Ridzuan, Malaysia (hereinafter referred to as "UTP").

2. The facts deposed to herein are to the best of my knowledge and belief true and are within my personal knowledge and from the records of UTP to which I have access.

3. I am authorized to make this statutory declaration for and on behalf of UTP.

4. On or about January 2015, **NURUL HUSNA BINTI MUKHTAR (930807-06-5018)** and I as employees of UTP (hereinafter referred to as "Authors"), have developed a system and method for improving the social behavior of the special-needs children by teaching turn taking. This robotic application is able to play shapes game with the special-needs children and dance after they accomplish the task correctly. SOCIABOTS is a partially automated interactive robotic approach in order to tackle the difficulties of special-needs children in establishing social behavior. The SOCIABOTS is programmed using Choreographe and for the hardware it uses NAO Humanoid Robot. The flow of how SOCIABOTS works is shown in Figure 1.

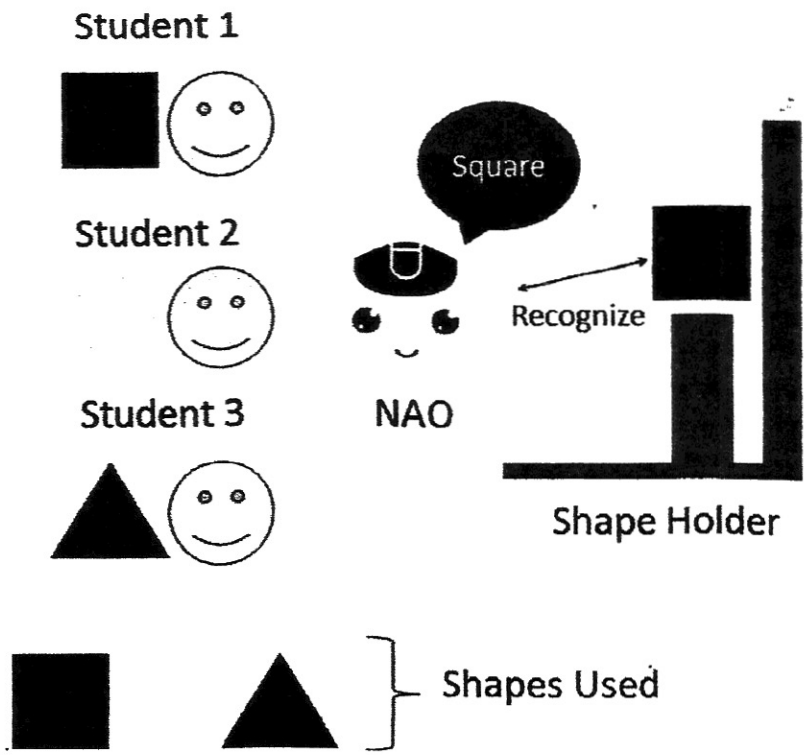

Figure 1: How SOCIABOTS work

5. On or about **9 July 2015** the development of the source codes was completed.

Now produced and marked as exhibit "SOCIABOTS". The source codes and screen shots from the "Robotic Approach for Special Education Children to improve their Social Skills".

6. I am advised and verily believe that computer programs or compilations of computer programs including source codes are Literary Work within the meaning of the Copyright Act 1987 and by virtue of that, the copyright subsists in the Literary Work on the date of creation.

7. I verily believe that since sufficient skill and effort has been expended in the creation of the Literary Work by the Authors to make the Literary Work original in character and that the Literary Work have been reduced into material form,

the copyright in the Literary Work subsists from the date it was made or created as stated herein.

8. I further assert that by virtue of the facts deposed to hereinbefore, the UTP is the owner of the copyright in the computer program which includes the source codes and all materials arising therefrom.

AND I make this solemn declaration conscientiously believing the same to be true and by virtue of the provisions of the Statutory Declarations Act 1960.

Subscribed and solemnly)
declared by the above named)
Norshuhani Binti Zamin
at Seri Iskandar)
on this **13** of **JULY, 2015**)

Before me,

PESURUHJAYA SUMPAH
No: A 199
Nama: SABTIAH B[illegible]
MALAYSIA

Commissioner for Oaths

No. 55, Jalan Maju 1,
Taman Maju,
[illegible] Bandar Seri Iskandar,
Perak.

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of the Copyright Act 1987.

This is the document marked **DRA-1**
Referred to in the Statutory Declaration dated
This **13** of **JULY, 2015**.

Before me,

PESURUHJAYA SUMPAH MALAYSIA
No: A 199
Nama: SABTIAH BINTI AHMAD

Commissioner for Oaths

No. 35, Jalan Maju 1,
Taman Maju,
32610 Bandar Seri Iskandar,
Perak.

BAHAGIAN PERANCANGAN DAN PENYELIDIKAN DASAR PENDIDIKAN
KEMENTERIAN PENDIDIKAN MALAYSIA
ARAS 1-4, BLOK E-8
KOMPLEKS KERAJAAN PARCEL E
PUSAT PENTADBIRAN KERAJAAN PERSEKUTUAN
62604 PUTRAJAYA.

Telefon : 03-88846591
Faks : 03-88846579

Ruj. Kami : KP(BPPDP)603/5/JLD.03 (97)
Tarikh : 24 Mac 2015

Nurul Husna binti Mukhtar
No.4 Kampung Bukit Chengal
Kubor Panjang
06760 Alor Star
Kedah

Tuan,

Kelulusan Untuk Menjalankan Kajian Di Sekolah, Institut Pendidikan Guru, Jabatan Pendidikan Negeri Dan Bahagian-Bahagian Di Bawah Kementerian Pendidikan Malaysia

Adalah saya dengan hormatnya diarah memaklumkan bahawa permohonan tuan /puan untuk menjalankan kajian bertajuk:

"AuduBots: A Robotic Approach for Special Education Children to Improve Their Social Skills" diluluskan.

2. Kelulusan ini adalah berdasarkan kepada cadangan penyelidikan dan instrumen kajian yang tuan/puan kemukakan ke Bahagian ini. **Kebenaran bagi menggunakan sampel kajian perlu diperolehi dari Ketua Bahagian/Pengarah Pendidikan Negeri yang berkenaan.**

3. Sila tuan/puan kemukakan ke Bahagian ini senaskah laporan akhir kajian/laporan dalam bentuk elektronik berformat Pdf di dalam CD bersama naskah *hardcopy* setelah selesai kelak. Tuan/Puan juga diingatkan supaya mendapat kebenaran terlebih dahulu daripada Bahagian ini sekiranya sebahagian atau sepenuhnya dapatan kajian tersebut hendak dibentangkan di mana-mana forum atau seminar atau diumumkan kepada media massa.

Sekian untuk makluman dan tindakan tuan/puan selanjutnya. Terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menurut perintah,

(DR.HJ.ZABANI BIN DARUS)
Ketua Sektor
Sektor Penyelidikan dan Penilaian
b.p. Pengarah
Bahagian Perancangan dan Penyelidikan Dasar Pendidikan
Kementerian Pendidikan Malaysia

JABATAN PENDIDIKAN PERAK
JALAN TUN ABDUL RAZAK,
30640 IPOH, PERAK DARUL RIDZUAN.

Telefon : 05-501 5000 Faks : 05-527 7273
portal : http://jpnperak.moe.gov.my

"1MALAYSIA : RAKYAT DIDAHULUKAN PENCAPAIAN DIUTAMAKAN"

Ruj. Tuan :
Ruj. Kami : J. Pel. Pk (AM)5114/4 Jld.18 (28)
Tarikh : April 2015

NURUL HUSNA BINTI MUKHTAR,
No. 4, Kampung Bukit Chengal,
Kubur Panjang,
06760 Alor Star,
Kedah

Tuan,

KELULUSAN UNTUK MENJALANKAN KAJIAN DI SEKOLAH - SEKOLAH DI NEGERI PERAK DI BAWAH JABATAN PENDIDIKAN NEGERI PERAK

Sukacitanya perkara di atas di rujuk dan surat tuan bertarikh 16 April 2015 dan surat dari Bahagaian Perancangan Dan Penyelidikan Dasar Pendidikan, Kementerian Pendidikan Malaysia, Rujukan :KP(BPPDP)603/5/Jld.03 (97), bertarikh 24 Mac 2015 adalah berkaitan.

2. Sehubungan dengan itu, dimaklumkan bahawa Jabatan Pendidikan Perak **tiada halangan** untuk membenarkan pihak tuan menjalankan kajian **"AuduBots; A Robotic Approach for Special Education Children to Improve Their Social Skills"** seperti dinyatakan dalam surat tuan dengan syarat-syarat berikut :-

2.1 Pihak tuan perlu mendapatkan kebenaran terlebih dahulu daripada Pegawai Pendidikan Daerah dan Pengetua sekolah untuk menggunakan sampel kajian;

2.2 Kajian yang dijalankan hendaklah tidak mengganggu proses pengajaran dan pembelajaran yang telah ditetapkan oleh pihak sekolah;

2.3 Pihak tuan bertanggungjawab menjaga keselamatan dan kebajikan guru-guru yang terlibat dalam kajian ini;

2.4 Pihak tuan hendaklah bertanggungjawab menanggung semua kos kajian;

2.5 Guru-guru/ murid tidak boleh dipaksa terlibat dengan kajian ini;

2.6 Pihak tuan dipohon agar mengemukan **satu (1) salinan laporan kajian dalam tempoh 30 hari** ke jabatan ini selepas kajian tersebut dilaksanakan; dan

2.7 Tiada sebarang implikasi kewangan terhadap Jabatan Pendidikan Negeri Perak, Pejabat Pendidikan Daerah dan pihak sekolah.

3. Sukacita juga dingatkan sekiranya sebahagian atau sepenuhnya dapatan kajian tersebut hendak dibentangkan di mana-mana forum atau seminar atau diumumkan kepada media massa, pihak tuan perlulah **mendapatkan kebenaran terlebih dahulu** daripada Bahagian Perancangan dan Penyelidikan Dasar Pendidikan Kementerian Pendidikan Malaysia dan satu salinan kepada Jabatan Pendidikan Negeri Perak.

4. Kebenaran permohonan ini adalah untuk tujuan yang dipohon dan melibatkan sekolah dalam daerah yang dinyatakan sahaja.

Sekian terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menurut perintah,

(NORHAZAMIN BIN MUHAMMAD YUSOF)
Penolong Pendaftar Institusi Pendidikan dan Guru,
Jabatan Pendidikan Perak.
b.p Ketua Pendaftar Institusi Pendidikan Dan Guru,
Kementerian Pendidikan Malaysia.

s.k
1. Pengarah Pendidikan Negeri Perak
2. Timbalan Pengarah Pendidikan Negeri Perak
3. Ketua Sektor Pengurusan Sekolah
4. Semua Pegawai Pendidikan Daerah

nmy/upp/kajiandisekolah/28/0415

UNIVERSITI
TEKNOLOGI
PETRONAS

Date: 7 March 2015
Ref: CIS/FYP/ Letter

To whom it may concern,

PERMISSION TO CONDUCT A PRELIMINARY STUDY TO SUPPORT A FINAL YEAR PROJECT RESEARCH

I would like to request for your kind support in giving access to below student (highlighted) to conduct a preliminary study at your premise / institution / company for the completion of their final year project development:

No.	Name	Student ID	Project Title
1.	Emmanuel Fallancy	16496	Greeny : A Robotic Approach as an Aid for Early Childhood Education
2.	Lee Kien Ee	16152	BEDRUNN3R: An Intelligent Running Alarm Clock
3.	Chong Vun Vui	16523	TJAssist: A Low Cost Car Autopilot System to Assist Driver on Traffic Congestion
4.	Ooi Wei Lynn	16012	Hang-and-Go: A Smart Laundry Hanging System
5.	Nurul Husna Mukhtar	16260	AuduBots: A Robotic Approach for Special Education Children to Improve their Social Skills

I would also like to further establish an official collaboration with your side if later you may find the project to be useful, feasible to be developed within the time frame and has a commercial value. Please personally contact me for further discussion.

Your cooperation is highly appreciated. Thank you.

Regards,

Dr. Norshuhani Zamin
FYP Supervisor,
Department of Computer and Information Sciences,
Faculty of Science and Information Technology.

KOLEJ
PERKEMBANGAN
AWAL KANAK-KANAK
B/4/P/8031

Ref: KPAKKBM/HEA/ 03-2015
Date: 4 April 2015

Dr. Norshuhani Zamin,
FYP Supervisor,
Department of Computer and Information Sciences,
Faculty of Science and Information Technology,
Universiti Teknologi Petronas.

Dear Dr,

COLLABORATIVE RESEARCH WITH UNIVERSITI TEKNOLOGI PETRONAS FOR UNDERGRADUATE FINAL YEAR PROJECTS

In referring to the above matter, on behalf of Kolej Perkembangan Awal Kanak – Kanak, we would like to collaborate with Universiti Teknologi Petronas for any project to be useful, feasible to be developed within the time frame and have a commercial value. We commit ourselves to work toward these goals in genuine partnerships with the research projects.

We also agree to support research effort that benefit both and also give our expertise on the education domain related to the investigated problems. The research projects and the students are involved as below:

No	Name	Student ID	Project Title
1	Emmanuel Fallancy	16496	GREENY: A Robotic Approach as an Aid for early Chilhood Education
2	Nurul Husna Mukhtar	16260	SOCIABOT: A Robotic Approach for Special Education Childeren to Improve their Social Skills

For this collaborative activity, Siti NurulAin Zakaria will be our contact person and can be reached at **nurulain.zakaria@e2l.com. my** and our office number is **058908801**.

We look forward to working with you on the exciting project.

Thank you.

Regards,

Nur Hamizah Bt Mat Yusoff
Academic Affairs (Bukit Merah),
Kolej Perkembangan Awal Kanak-Kanak.

Pusat Kemahiran Robotik DiRECT
No 29-1 Jalan Damai Niaga 1,
Alam Damai 56000 Cheras
http://www.creativeminds.edu.my

CREATIVE MINDS

Date: 1 May 2015

Attention to:
Dr. Norshuhani Zamin
Senior Lecturer / Principle Researcher
Universiti Teknologi PETRONAS,
Department of Computer and Information Science
Bandar Seri Iskandar, 31750,
Tronoh, Perak, Malaysia

Sir/Madam,

LETTER OF INTENT – INDUSTRIAL COLLABORATING PARTNER FOR COMMERCIALIZATION

Referring to the above mentioned subject, CREATIVE MINDS (managed by Pusat Kemahiran Robotik DIRECT) would like to become an industry collaborating partner with Universiti Teknologi PETRONAS (UTP). We are robotic education institution registered under Ministry of Education Malaysia.

We hereby announce our intent and are pleased to provide any kind of assistance to Universiti Teknologi PETRONAS (UTP). We would work together with Dr Norshuhani Zamin and her team members on a project entitled: **"SociaBots: A Robotic Approach for Special Education Children to Improve their Social Skills"**. Creative Minds is an authorized distributor for LEGO Education products and been collaborate with leading engineering firms on several robotic projects including research and training.

Part of our effort in promoting robotic education is through supporting engineering university such as UTP to bring promising product and prototype towards commercialization. We believe Dr Norshuhani's project are ideal and in line with our effort.

Therefore, we are prepared to provide assistances and contribute resources to this project.

Thank You.

Yours Sincerely,

Muhammad Shafiq Shahrul Amar
Founder & Principal
CREATIVE MINDS

SOCIABOTS: A Robotic Approach for Special Education Children to Improve their Social Skills

ORIGINALITY REPORT

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